SCIENCE & TECHNOLOGY POLICY INSTITUTE

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Executive Summary

The White House Office of Science and Technology Policy requested that the IDA Science and Technology Policy Institute (STPI) examine (1) the current state of plant breeding in the public and private sectors and (2) the educational pipeline for plant breeding. To determine the number of professional plant breeders and the crops that they work with, STPI research staff developed and sent a survey to heads of plant breeding departments and colleges at academic institutions and State Agricultural Experiment Stations (representing the public sector) and to commercial companies involved in plant breeding in the United States (representing the private sector). In total, STPI received 82 completed surveys from 70 public sector institutions and 14 completed surveys from 22 private sector companies. In addition to gathering information via surveys, STPI research staff collected institutional research data and conducted interviews. This research builds upon previous surveys of public sector plant breeders done in 1994, 2001, and 2013, which were led by Kenneth Frey, Greg Traxler, and Thomas E. Carter, Jr., respectively.

Respondents to STPI's public sector survey reported the amount of work spent on cultivar development for 147 different crops or crop categories. A comparison of this amount of reported effort with the amounts reported in the 1994 and 2001 surveys showed a decreased amount of cultivar development effort in the public sector for ten crops or crop categories. STPI's survey results also showed an increased amount of cultivar development work in the public sector for six crops, four of which are fruit crops. Respondents were also asked directly whether cultivar development programs had stopped in the past 10 years, and, if so, why. The two most common reasons given for the cessation of cultivar development programs were lack of funding and (2) retirement of plant breeders (without subsequent replacement).

STPI research staff interviewed heads of plant breeding departments and colleges at academic institutions to determine where students who receive PhDs in plant breeding find jobs. Most interviewees reported that the majority of students go into the private sector, with large seed companies being the most common employer. Interviewees reported that this is due to a greater number of available jobs, greater availability of resources, better technical support, better compensation, and a lower teaching load compared to academic positions.

To be able to examine whether significantly more jobs can be found in the private sector compared to the public sector, as well as determine the typical salary difference between the public and private sectors, STPI research staff included survey questions that

asked for the expected number of plant breeding jobs to be offered in the next 12 months at respondents' institutions or companies and for the typical starting salary for an assistant professor in plant breeding or an entry-level PhD plant breeding employee. While interviewees reported greater availability of jobs in the private sector than in the public sector, STPI research staff found that the number of domestic private sector positions in plant breeding is only a third larger than the number of domestic academic positions. This could be a consequence of either the larger number of faculty searches expected in the next year (as reported by interviewees) or the incomplete set of survey responses from the private sector, or both. But when international plant breeding positions are considered, nearly three times as many private sector positions are anticipated. The salary distribution showed that plant breeders in the private sector typically are offered starting salaries that are approximately $14,000 higher than those offered at State Agricultural Experiment Stations (SAESs) and that are approximately $28,000 higher than those offered at non-SAES institutions.

One concern during this study was the sustainability of the public sector plant breeding workforce when the private sector has competing cultivar development programs. The survey responses indicate decreases in the number of public sector plant breeders working with soybeans and corn, among other crops. The interviews and survey responses suggest that this decline may be due to the increasing role of the private sector in developing, patenting, and selling seeds for these crops, which outcompetes the public sector plant breeders. Given the competitiveness of the private sector in certain crops, it is unclear what the role of public sector plant breeders should be. One interviewee posed three different roles for the public sector: (1) continue cultivar development programs in case the industry fails, (2) continue cultivar development programs because the role of the public sector is to educate the plant breeders that go into the private sector, or (3) cease cultivar development programs because they cannot compete with the private sector. This question of the appropriate role of the public sector is still relevant due to potential changes in wheat breeding. Interviewees pointed out that the private sector could soon outcompete the public sector in wheat breeding if the private sector develops competitive hybrids. The public sector survey results indicated that of any crop category, wheat currently has the highest number of dedicated plant breeders, and the private sector survey results indicated that at least five companies have wheat cultivar development efforts. If the private sector does develop competitive wheat hybrids, it may have significant implications for the number of plant breeders in the public sector and the direction of their research, as well as for the training of students in plant breeding.

Contents

A. Introduction

The Office of Science and Technology Policy asked the IDA Science and Technology Policy Institute (STPI) to examine plant breeding education and research in the United States. Specifically, STPI was to answer the following questions:

1. How many professional plant breeders are there?
2. What crops do plant breeders work on?
3. How many jobs are available for plant breeders?
4. How many college students graduate from plant breeding programs?
5. What are the major sources of funding for graduate and post-graduate study in plant breeding?
6. What career paths are sought by graduates of plant breeding programs?

The first two questions have been studied in previous studies (Frey 1994; Traxler et al. 2001; Carter et al.). To answer questions 1–3, a team of STPI researchers developed surveys for the public and private sectors[1] and supplemented the survey results with information from web-based research into universities that were identified to have programs related to plant breeding. To answer question 4, STPI research staff gathered data from institutional research offices at colleges and universities (hereafter referred to as "academic institutions") with plant breeding programs. To answer questions 5 and 6, interviews were conducted with heads of departments, colleges, centers, laboratories, and other entities (hereafter referred to as "departments") within the academic institutions that have plant breeding programs.

B. Methodology

1. Identification of Departments with Plant Breeding Research Efforts

Earlier studies of public sector plant breeding programs looked only at universities with State Agricultural Experiment Stations (SAESs).[2] STPI research staff pursued a different approach by looking into all academic institutions in the United States with plant

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[1] In this report, "public sector" refers to academic institutions and State Agricultural Experiment Stations only. STPI research staff attempted to gather information on employment and funding for plant breeding within the United States Department of Agriculture's Agricultural Research Service, but no data were available.

[2] Most contacts at SAES institutions were at the department level. In two cases, University of Wisconsin-Madison and Washington State University, department heads referred STPI research staff to SAES directors.

breeding research programs. This decision was made both to ensure that all possible plant breeders were counted and to secure information about how plant breeding research varies among types of academic institutions. We created an initial list of academic institutions using the following sources:

- United States Department of Agriculture (USDA) Partners and Extension Map: lists of all land-grant institutions in 1862, 1890, and 1994[3]
- Science Societies Career Center: list of colleges and universities with agronomy, crop science, soil science, and environmental science programs/courses [4]
- SeedQuest Company Index: list of companies and universities in the United States that house seed professionals[5]
- Department of Education: list of accredited Historically Black Colleges and Universities (HBCUs)[6]

Each institution's involvement in plant breeding-related activities was verified by searching for each institution on USDA's Current Research Information System (CRIS).[7] Institutions with any records of grants with key words related to plant breeding[8] were labeled as "active in plant breeding." For institutions without such records, we searched institutional websites for faculty who participated in plant breeding efforts. If we found no evidence of plant breeding efforts, we removed the college or university from our list and no survey was sent.

Completeness of the resulting academic list was ensured by searching the CRIS using the same set of plant breeding-related key words, but without specifying a college or university. Ten new institutions not previously identified were found using this method.

Individual departments with plant breeding research programs were identified from the four original data sources, and the affiliated academic institution for these departments were derived from CRIS search results. Multiple departments within the same institution

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3 USDA, National Institute of Food and Agriculture website, "Partners and Extension Map," http://nifa.usda.gov/partners-and-extension-map, accessed August 2015.

4 Science Societies Career Center website, "Colleges and Universities," https://www.careerplacement.org/colleges, accessed August 2015.

5 SeedQuest website, "Career Center," http://www.seedquest.com/jobs.php?sm=list, accessed August 2015.

6 Department of Education website, "What Is an HBCU?" http://sites.ed.gov/whhbcu/one-hundred-and-five-historically-black-colleges-and-universities/, accessed August 2015.

7 USDA, National Institute of Food and Agriculture website, "Current Research Information System," http://cris.nifa.usda.gov/, accessed August 2015. The search criteria used was as follows: project type and project status data fields were left open not only to retrieve information on any type of contract, cooperative agreement, or grant, but also the full recent history of projects at the institution (active, new, terminated, extended, revised, or pending).

8 Key words used to select for schools with research related to plant breeding were: "plant breeding"; "germplasm"; and "cultivar development".

were included if they had separate administrative staff. The complete list of institutions and the specific departments contacted is located in Appendix A, Table A-1.

2. Survey Development for the Public Sector

STPI researchers developed and tested the survey first internally at STPI and then with three external reviewers, one USDA employee and two department chairs from SAES institutions. Feedback received from each reviewer was used to revise the survey.

The resulting survey, reproduced in Appendix A, was sent to heads of departments of the academic institution identified (Appendix A, Table A-1). To ensure that faculty were not double-counted for institutions where multiple department heads were contacted, we informed them about each other and asked for department-level data only in their respective survey responses.

Department heads who did not respond received two email reminders. If, after the three emails, no response was received, we followed up with at least one phone call to the department office or personnel office.[9]

3. Public Sector Interviews

To ensure representation from a diverse range of academic institutions with cultivar development programs, we categorized public institutions according to three criteria: (1) whether or not the respondent is from a land-grant institution; (2) if the respondent is from a land-grant institution, whether or not the institution is an SAES; and (3) whether the respondent is from an institution in the smallest, middle, or largest third of in terms of size, as determined by the number of undergraduates. All SAES universities are also land-grant institutions, but not all land-grant institutions are an SAES site.[10] Public institutions were thus identified for the following categories:

- Small, non-land-grant, non-SAES
- Small, land-grant, non-SAES
- Medium, non-land-grant, non-SAES
- Medium, land-grant, non-SAES
- Medium, land-grant, SAES
- Large, non-land-grant, non-SAES
- Large, land-grant, SAES

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[9] The one exception was the University of Guam, since the phone number did not seem to be in order.

[10] The Connecticut Agricultural Experiment Station is an exception in that it is not affiliated with a university.

Where possible, three geographically distributed institutions were contacted for each category. The following questions were asked of each department head:

- After graduating with a bachelor of science in plant breeding-related fields, where do undergraduate students go? If they go on to PhD programs, what kind of programs? If they go on to jobs, what kind of jobs, and are they domestic and international?
- What careers do PhD plant breeding students go into after earning their PhDs? Are these jobs taken due to job availability or desire for those jobs?
- Among undergraduate students in plant breeding-related fields, what is the approximate ratio of domestic students to international students? What is the ratio for PhD students?[11]
- What are the major sources of graduate and post-graduate funding for students doing cultivar development?
- What, if anything, has changed in the past 10 years in plant breeding at your institution?

4. Identification of Private Sector Companies that Employ Plant Breeders

Private sector companies that employ plant breeders were identified through the membership and leadership websites of the National Association of Commercial Plant Breeders (NACPB) and through recommendations by plant breeding contacts. The complete list of companies contacted is in Appendix B.

5. Survey Development for the Private Sector

STPI researchers developed the survey and tested it first internally at STPI and then with two external reviewers associated with NACPB. Feedback received from each of the reviewers was used to revise the survey.

The resulting survey, reproduced in Appendix B, was sent to the initial list of 17 companies (also in Appendix B). Each recipient received an initial email, and if no response was received, one reminder email. Following a low response rate from the reminder email, an email was sent via NACPB. This email expanded the number of companies contacted to 22 companies. Following this email, each of the original contacts that had not responded to the survey received a phone call.

[11] These questions were asked in order to contextualize information about students finding jobs in the United States and abroad.

C. Results from Survey of Academic Institutions

In total, 89 academic institutions (colleges, universities, and the Connecticut Agricultural Experiment Station, which is the only SAES unaffiliated with a university) were in our survey pool. Because there were sometimes multiple relevant departments within an institution, 106 survey responses were sought in total. Of the 89 institutions contacted, 72 are land-grant institutions and 17 are non-land-grant institutions. The 72 land-grant institutions include 50 institutions that are also SAES sites, 14 that are 1890 land-grant institutions, 6 that are 1862 land-grant institutions,[12] and 2 that are 1994 land-grant institutions.[13]

In total, 82 completed surveys were received from 70 institutions. Three surveys were not completed because the survey was not applicable, the individual was unable to answer, or survey responses had been included with those of another department at the same institution. The remaining 21 individuals, each from a different institution, did not complete the survey. The list of contacted institutions by department is included in Appendix A (Table A-1). The number of responses and the response rate by type of institution are shown in Table 1.

Table 1. Survey Response Numbers and Rates, by Respondents' Type of Institutional Affiliation

Type of Institution	Number of Responses
SAES[a]	59 (89%)
Non-SAES land-grant[b]	11 (48%)
Non-land-grant	11 (65%)

[a] The response numbers and rates are calculated using the total number of departments contacted, rather than the total number of institutions. A total of 50 SAES institutions were contacted, including the Connecticut Agricultural Experiment Station. The University of the District of Columbia was not contacted because neither its grant record nor its website indicated any plant breeding activity.

[b] Of these 11 responses, 2 are from 1862 land-grant institutions, 8 are from 1890 land-grant institutions, and 1 is from a 1994 land-grant institution. The response rate among 1890 land-grant institutions contacted was 57%.

[12] The 1862 land-grant institutions are American Samoa Community College, Community College of Micronesia, Northern Marianas College, University of California – Riverside, University of Guam, and University of Puerto Rico.

[13] The 1994 land-grant institutions are White Earth Tribal and Community College and United Tribes Technical College.

1. Current Cultivar Development Efforts in the Public Sector

Our survey was designed to be able to compare data with that of the 1994 and 2001 surveys of plant breeding done by Frey (1996) and Traxler et al. (2001), respectively.[14] Because these surveys asked for the amount of work done in units of "Science Person Years," STPI provided the same definition of "Science Person Year" as provided by Traxler et al. Respondents were also asked not to guess, but to provide only accurate and verified data.

Thirteen survey respondents replied that they did not have cultivar development efforts. This included seven institutions with agricultural experiment stations. Survey respondents who indicated that they do have cultivar development efforts were prompted with a list of crops from the USDA National Institute of Food and Agriculture Manual of Classification (USDA 2013). All edible, oil, or fiber crops were listed individually. Two crop classes (pasture and forage crops and ornamental and turf crops) were kept whole. Miscellaneous and new crops were not included in the list of crops presented to the respondents. For each crop, survey respondents were asked to click on the number of Science Person Years (SPYs) dedicated to cultivar development. They were given the following options: 0, between 0 and 1, 1, 2, 3, 4, 5 or more, and I don't know. A complete list of the number of SPYs dedicated to different crops and crop types from the survey data is included in Appendix A, Table A-2. Approximate values for the number of SPYs are given by approximating "between 0 and 1" as 0.5 and "5 or more" as 5.[15] Respondents were also permitted to write in any crops that they did not see mentioned in the list provided (such as miscellaneous and new crops).

2. Change in Cultivar Development Effort by Crop

To determine how the amount of effort dedicated to cultivar development has changed since the 1994 and 2001 surveys, we restricted the data set to respondents at SAES institutions since these were the only institutions previously surveyed.

Comparison with previous studies was complicated by differences in categorization and naming of crops. For example, in the 1994 and 2001 surveys, wheat, cotton, and grapes were listed rather than particular types of these crops. For this reason, survey results were aggregated for these three crop categories for ease of comparison with previous study results. Other crops were categorized differently in the 1994 and 2001 surveys. Results for "leafy and bulbous and stem vegetables" were used to compare with the crop category of

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[14] The results presented in Carter et al. (2014) were not used because the cultivar development results were presented in different units than the Frey and Traxler et al. studies. The 2014 paper reported number of programs per crop, rather than number of Science Person Years per crop.

[15] In some cases, we were able to follow up with the survey respondent to get an exact number of SPYs for the case in which they had indicated "5 or more" SPYs.

green and leafy vegetables, the results for ornamentals and "lawn and turf" crops were combined to compare with ornamental and turf crops, and the results for "forage" crops were used to compare with "pasture and forage" crops. Certain crops, such as citrus, peppers, sweet corn, and sweet potatoes were missing from the 1994 or 2001 reports. Therefore, these crops were not included in the comparison.

Due to imprecision in the counting of "between 0 and 1" and "5 or more" SPYs (which are estimated to be 0.5 and 5 SPYs, respectively), only crops that seem to have increased or decreased by five or more SPYs since 1994 and 2001 are reported.

Ten crops or classes of crops decreased by five or more SPYs at SAES institutions either since 1994 or since 2001. They are shown in Table 2.

Table 2. Crops with Decreased Effort
(The crops for which the number of SPYs at SAES institutions decreased by 5 or more since either 1994 or since 2001 are shown below)

	Number of SPYs at SAES Institutions				
Crop	**1994**	**2001**	**2015**	**Change since 1994**	**Change since 2001**
Ornamentals and turf (total)	33.0	54.6	30.0	–3.0	–24.6
Soybean	45.0	43.3	20.5	–24.5	–22.8
Potato	31.0	18.6	15.0	–16.0	–13.0
Peanut	14.0	14.4	4.0	–10.0	–10.4
Melons	4.4	12.2	3.5	–0.9	–8.7
Greens and leafy vegetables*	5.8	16.0	8.0	2.2	–8.0
Corn (not sweet)/dent corn	27.1	29.2	21.5	–5.6	–7.7
Pasture and forage crops (total)	37.8	26.1	19.0	–18.8	–7.1
Tomato*	20.65	7.0	11.0	–9.65	4.0
Wheat (total)*	64.5	54.7	56.0	–8.5	1.3

* These crops show an increase since 2001 but a decrease since 1994.

Crops that had an increase in the number of SPYs dedicated are shown in Table 3.

Table 3. Crops with Increased Effort

(Crops for which the number of SPYs dedicated at SAES institutions increased by 5 or more since either 1994 or since 2001 are shown below)

	Number of SPYs at SAES Institutions				
Crop	1994	2001	2015	Change since 1994	Change since 2001
Grapes, (total)	7.1	3.9	13.5	6.4	9.6
Sugar (total)	4.4	4.0	11.5	7.1	7.5
Beans (total)	13.3	9.0	16.5	3.2	7.5
Apple	4.2	4.0	11.0	6.8	7.0
Strawberry	7.4	2.5	9.5	2.1	7.0
Cherry	0.5	1.3	7.5	7.0	6.2

The list of SPYs per crop does not include results from departments for which we did not receive responses. To supplement the survey response set, and to aid in follow-up studies, STPI research staff examined the faculty websites for all departments that were determined to have plant breeding programs. Based on this information, STPI research staff compiled a list of the faculty with plant breeding-relevant research, the crops that they work on, and their position at their college or university. This list is contained in Appendix A, Table A-3. Using this list of faculty, STPI research staff estimated that the survey results do not include 103 faculty members, or 17% of total domestic plant breeding faculty members. Of these 103 faculty members, 67 are affiliated with an SAES institution.

The list of faculty from schools that did not respond were analyzed to examine which crops might be underrepresented in the survey results. STPI research staff assumed an equal amount of time distributed to each of the crops listed on a faculty member's websites. The maximum amount of missing SPYs was estimated by assuming that a faculty member devotes 100% of his or her time to cultivar development. In reality, this number is likely to be much lower due to teaching and administrative duties. The crops for which STPI research staff estimate that more than one SPY is missing from the survey data are shown in Table 3.

Table 4 lists the 18 crops or crop classes that STPI research staff estimate to be missing more than one SPY. For some crops, like potatoes, the survey results represent a true or real decrease, and cannot be attributed to survey nonresponse. In other crops, it appears that the survey results overestimate the decreases in SPYs, though the decreases are still significant. This is the case for soybeans, which display a drop of more than 18 SPYs at SAESs since 2001, and ornamentals and turf, which display a drop of 12.6 SPYs at SAESs since 2001, even when data from department heads that did not respond to the survey are taken into account.

Table 4. Estimated Missing Number of Science Person Years for Different Crops

Crop	Estimated Number of SPYs Missing	
	From SAES Institutions	From Both SAES and Non-SAES Institutions
Ornamentals and turf	12	16
Wheat	6	6
Grapes	2	5
Soybean	4	5
Tomato	3	4
Pasture and forage crops	3	4
Sweet potato	1	4
Rice	1	4
Biofuel crops	2	3
Blueberry	2	3
Cotton	2	3
Canola	1	3
Peanut	1	3
Barley	3	3
Millet	1	2
Corn	1	2
Medicinal crops	1	2
Mushrooms	1	2

Note: This table shows only the crops for which STPI research staff estimates that more than one SPY is missing.

Survey respondents were also asked directly whether any cultivar development programs had stopped in their departments. Respondents from 22 SAES institutions reported that they have stopped cultivar development programs within the past 10 years. Four of the 22 institutions had two different departments stop cultivar development programs. Three respondents from non-SAES land-grant institutions and three respondents from non-land-grant institutions indicated that they had cultivar development programs stop within the past 10 years. Table 5 shows crops that were mentioned and the number of departments that mentioned the programs stopping.

Table 5 indicates that soybeans and pasture and forage crops are the most common crops to have had discontinued cultivar development programs, followed by oats and ornamentals and turf. These results are consistent with the decrease in the number SPYs dedicated to these crops that was found by comparing previous survey data with the current survey data.

Table 5. Number of Responses, by Crop, Reporting Cessation of a Plant Breeding Program in the Last 10 Years

Crop	Number of Responses Citing Program Cessation
Alfalfa	3
Apples	2
Beans (dry)	1
Breadfruit	1
Canola	2
Carrot	1
Cereal	1
Cherries	2
Clover	1
Cole crops	1
Corn	3
Cotton	2
Cucurbits	1
Cuphea	1
Dragonfruit	1
Eggplant	1
Fruit (unspecified)	1
Grapes (table)	1
Guava	1
Legumes	1
Lettuce	1
Meadowfoam	1
Milkweed	1
Mint	1
Oat	4
Onions	1
Ornamentals and turf	4
Papaya	1
Pasture and forage crops	5
Peach	2
Peas (green)	1
Peanuts	2
Pole bean	1
Popcorn	1
Raspberry	2
Sorghum	1
Soybeans	5
Strawberry	1
Sunflower	1
Sweetcorn	2
Switchgrass	1
Tomatoes	1
Trefoil	1
Vegetables (unspecified)	1
Yam	1

3. Changes in Cultivar Development by Department

Survey respondents were also asked, how, if at all, has the number of SPYs devoted to cultivar development changed over the past 10 years. The results for respondents at SAES institutions, non-SAES land-grant institutions, and non-land-grant institutions are shown in Figure 1.

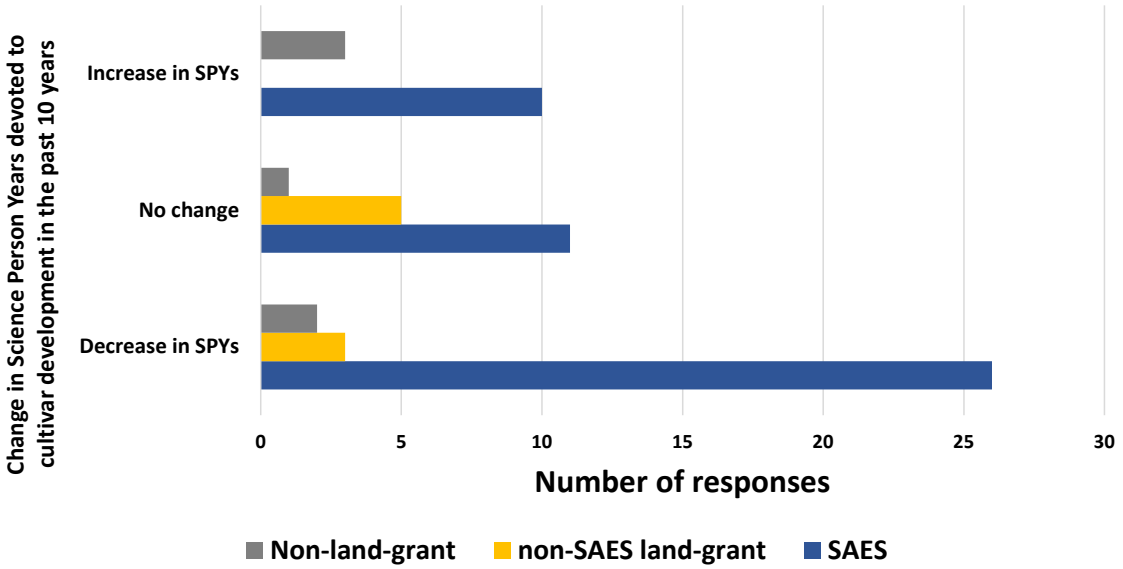


Figure 1. Change in Number of Science Person Years Devoted to Cultivar Development in the Past 10 Years, by Type of Institution

Of the six respondents at non-land-grant institutions, three indicated an increase in the SPYs devoted to cultivar development in the past decade, two indicated a decrease, and one indicated no change. Of the eight respondents at non-SAES land-grant institutions, none reported an increase in the number of SPYs devoted to plant breeding in the past decade. Five respondents reported no change, and the remaining three respondents reported a decrease. Among respondents at SAES institutions, the most common response was that of a decrease in the number of SPYs devoted to cultivar development (55% of respondents). A nearly equal number of respondents indicated an increase in SPYs over the past decade (10 responses, 21%) or no change in SPYs (11 responses, 23%).

4. Reason for Reduction in Plant Breeding Effort

If respondents indicated that any cultivar development programs had stopped in the past 10 years, they were asked why they stopped. The most common reason given by respondents was a lack of funding, with 16 responses. The second most common reason was the retirement of faculty members, with 10 responses. These two groups of responses may be linked if retired faculty members are not replaced due to lack of funding, a situation

that is supported by two respondents reporting a lack of replacing faculty positions. Respondents also mentioned issues with faculty members leaving (five responses) and faculty members having difficulty receiving tenure (two responses). Another reason given for cultivar development programs stopping is the private sector supplanting the role public sector breeding efforts (two responses), with one respondent writing that there is a "reduction in need for breeders to produce finished cultivars since the seed industry has greater resources and breeding stations to generate superior cultivars. Widespread use of commercially patented transgenic corn and soybeans has supplanted the role of public institutions in developing finished cultivars in these species." Single responses also indicated the following reasons: intellectual property issues, long harvest times making the programs unsustainable, a lower priority in industry, and competition from larger States.

5. Faculty Positions

Survey respondents were asked whether their institutions plan to hire additional plant breeders within the next 12 months, and if so, how many. The results are shown in Figure 2.

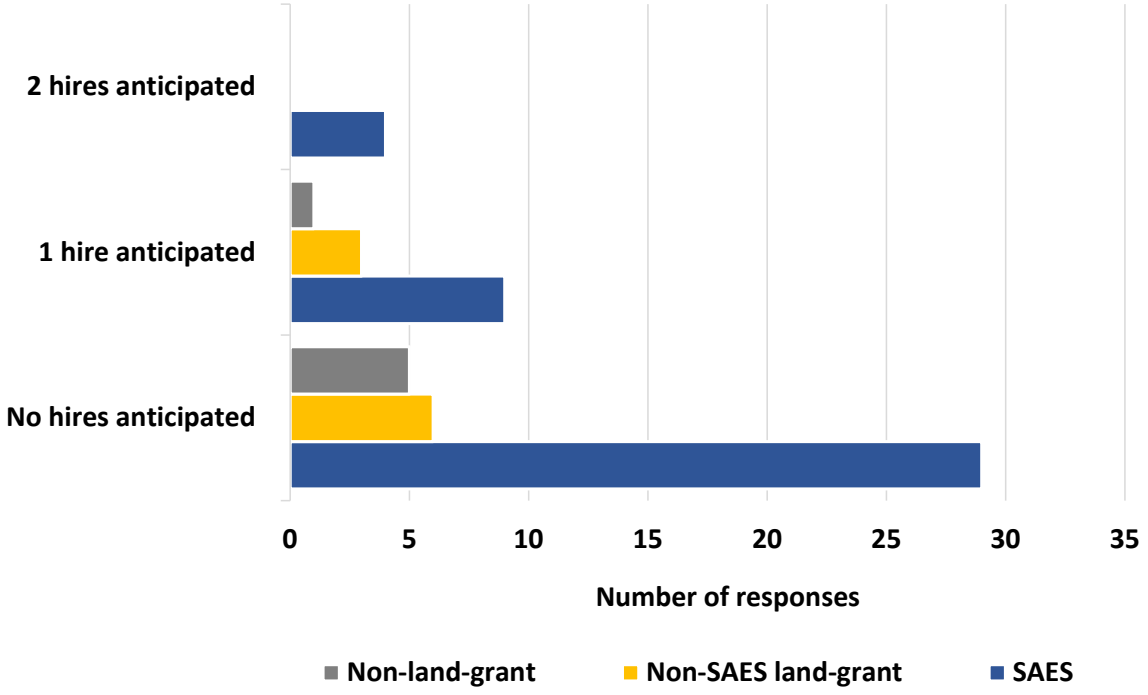


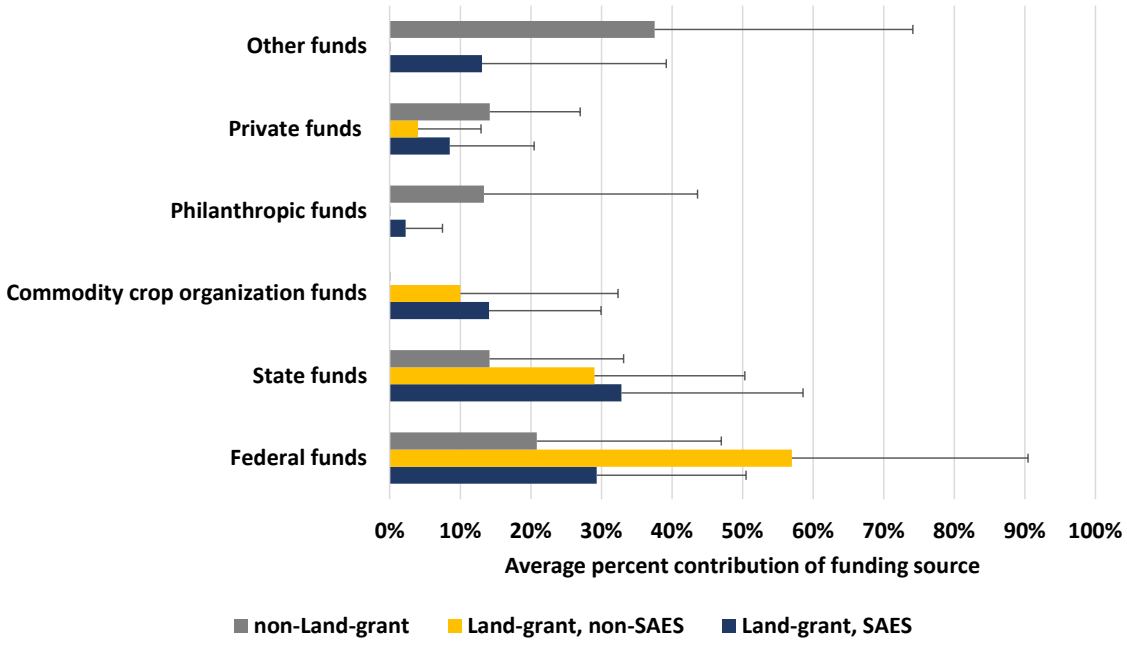
Figure 2. Planned Hires for the Next 12 Months for Respondents, by Type of Institution

This figure shows that the majority of respondents at all types of institutions do not anticipate hiring any faculty in the next 12 months. One respondent at a non-land-grant institution (out of six who responded to the question) expected to hire a faculty member. Three at non-SAES land grant institutions (out of the nine that responded to the question)

expect to be hire faculty, and 13 respondents from SAES institutions expect to hire faculty, which represents 31% of responses. In total, 21 faculty positions are anticipated.[16]

6. Departmental Funding

Public sector survey respondents were asked whether or not Federal and State funds cover their institution's operating costs. If they knew the answer, respondents were also asked to indicate the percentage of funding their departments receive from each of the following sources: Federal funds, State funds, commodity crop organizations, philanthropic organizations, private industry, and other. A total of 37 responses were received in which the total percentage of funding distributed among the different options added up to between 99% and 101%.[17] The average replies for land-grant SAES institutions, land-grant non-SAES institutions, and non-land-grant institutions each differed, and the standard deviation in the response are shown in Figure 3.



Note: Error bars represent one standard deviation.

Figure 3. Average Percentage of Contributions by Funding Sources

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[16] Three respondents that reported having cultivar development efforts also reported that they did not know whether additional faculty members would be hired in the next months, so this number may be higher.

[17] Responses that added up to between 99% and 101% but did not add up to 100% were normalized to 100%.

There is significant variation in the funding profile for all institution types. The most common funding sources for land-grant institutions are Federal and State funds. Among respondents from SAES institutions, the combination of Federal and State funds covers an average of 62%, with Federal and State funds providing nearly equal support. Commodity crop organizations and "other" account for an additional 27% of funding. Private industry and philanthropic organizations contribute 8% and 2%, respectively.[18]

Among respondents from non-SAES land-grant institutions, Federal funds represent a much larger share of funding at 57% and the average percentage of State funding (29%) is nearly the same as for SAES institutions. Commodity crops and private industries contribute 10% and 4%, respectively, which is much less than for SAES institutions.

Among respondents from non-land-grant institutions, "other" funding dominates with 38%, though there is a large range for individual responses. The combination of State and Federal funding covers an additional 35%, and private industry and philanthropy fund an average of 14% and 13%, respectively.

Survey respondents who indicated that their institution received a large portion (at least 25%) of their funding from "other" sources were asked for clarification on their sources of funding. Survey respondents replied that these sources are tuitions, royalties from intellectual property licenses, money from commodity marketing, and research fees.

D. Results from Survey of Private Sector Companies

Of 21 companies contacted with the plant breeding survey, 14 completed the survey.[19] Two companies replied that the survey was not applicable because they did not conduct plant breeding research. The companies that responded range in size from employing fewer than 5 PhD-level plant breeders to more than 100 PhD-level plant breeders.

1. Current Cultivar Development Efforts in the Private Sector

Private sector respondents were asked for the number of PhD-level plant breeders employed domestically and internationally. The 14 companies that responded employ a total of 700 PhD-level plant breeders, 344 of whom are employed domestically, and an additional 75–100 plant breeders that do not hold PhDs. These companies were also asked to identify the crops for which they have cultivar development programs. The list of crops and the number of companies working on each of them is shown in Appendix B, Table B-1.

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[18] Note that percentages appear to add to 99% due to rounding.

[19] Two respondents from larger companies gave responses for the portions of their companies that they are most familiar with.

2. PhD-Level Plant Breeding Positions Available

Private sector survey respondents were asked for the number of PhD-level plant breeders they anticipate hiring. From the 14 companies that responded, a total of 28 PhD-level plant breeders are anticipated to be hired domestically in the next 12 months, and an additional 33 positions are anticipated outside the United States. The number of positions available in the next year may actually be higher since the survey respondents do not represent a complete set of companies that employ plant breeders

3. Preparation of Plant Breeding Applicants

Private sector respondents were asked for their level of agreement or disagreement with the following statement: "We have enough qualified applicants for entry-level plant breeding positions." There was no clear consensus from the responses. Seven respondents indicated that they somewhat disagree and six indicated that they somewhat agree. One respondent strongly disagreed.

E. Comparison of Public and Private Sector Results

1. Positions Open in the Public and Private Sector

To look at the job pipeline for plant breeders, both public and private sector survey respondents were asked for the number of jobs they anticipate opening in the next 12 months. Within academic institutions, 21 plant breeding faculty positions are anticipated in the next 12 months. Within the private sector, 28 plant breeding positions are anticipated domestically and 33 are anticipated internationally. This indicates that there are approximately one-third more entry-level positions available for PhD-level plant breeders in domestic private industry compared to academia, and nearly three times as many available globally in private industry compared to academia.

2. Salary for New PhDs in the Public and Private Sector

Both the public and private surveys asked respondents about the starting salary for entry-level PhD plant breeders. The public sector survey also asked about the starting salary for an assistant professor in plant breeding, and the private sector survey also asked about the starting salary for a PhD plant breeder. Figure 4 shows the distribution of results from both private and academic institutions.

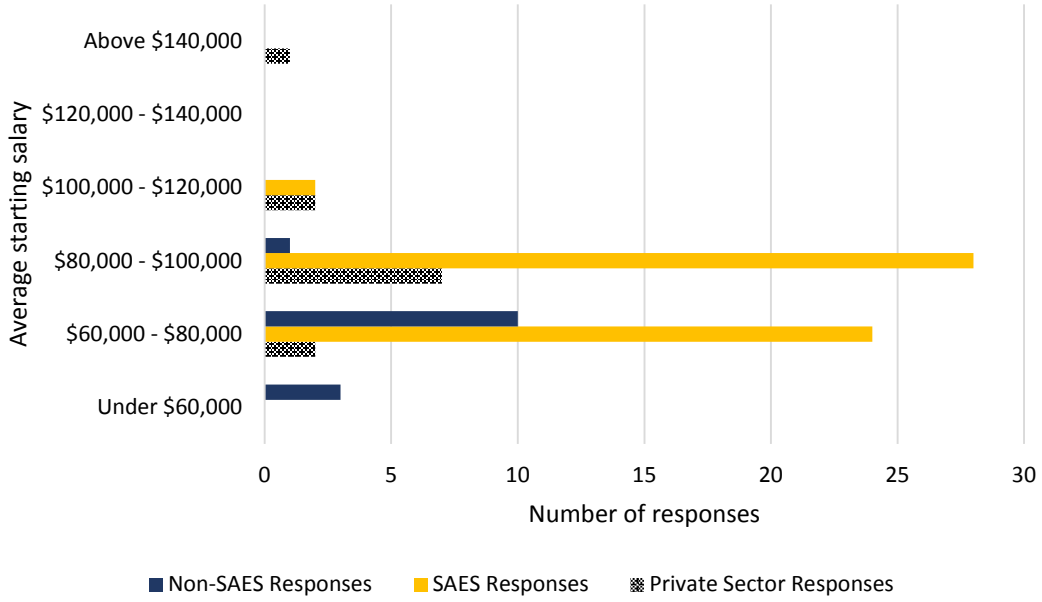

Figure 4. Average Starting Salary for PhD-level Plant Breeders

Within the private sector, the most common salary range is between $80,000 and $100,000. This is the same as the most common starting salary for assistant professors at SAES institutions. While only 17% of private sector respondents indicated that their typical salary is between $60,000 and $80,000, approximately 46% of respondents from SAES institutions selected this salary range. In addition, while 25% of private sector respondents said that the typical salary was above $100,000 (with one respondent reporting that the starting salary is above $140,000), no respondents from SAES institutions chose this option. At non-SAES institutions, only one respondent indicated that their typical starting salary is between $80,000 and $100,000. The most typical response was between $60,000 and $80,000, with three additional respondents indicating that the starting salary is under $60,000.

Average salary was calculated using the distribution of salaries within the private sector and the public sector separately. The average salaries and the standard deviations are shown in Table 6.

The average salary for an entry-level PhD plant breeder in the private sector is approximately $14,000 more than the average salary for an assistant professor at an SAES institution, and $28,000 more than that of an assistant professor at a non-SAES

institution.[20] The large standard deviation for each of the average salary values means that the differences in salary could be significantly lower or higher.

Table 6. Summary of Findings on Salary

	Average Salary*	Standard Deviation**
Entry-Level PhDs in Private Sector	$95,000	$21,106
Assistant Professors in Public Sector		
At SAES Institutions	$80,769	$9,970
At Non-SAES Institutions	$67,143	$10,690

* The figure $40,000 was used as a lower bound for salaries in the under $60,000 category and the figure $150,000 was used as an upper bound for salaries in the above $140,000 category. The average was calculated by taking the weighted average of the mean salary of each bin range, without considering the difference in number of employees at each organization.

** Standard deviation was calculated by using the bin mean. For example, the two private sector responses in the $60,000–$80,000 range are assumed to represent two salaries at $70,000 each. The real sample standard deviation could be higher or lower depending on the actual distribution of salaries within each bin.

F. Results from Interviews

Interviews were conducted with 13 faculty members or department heads at institutions ranging from small, non-land-grant institutions to large SAES institutions. Not all questions were relevant to all interviewees. For example, some institutions that were contacted do not offer graduate programs. Due to the small sample size, the results are not summarized statistically and are intended as anecdotal. One interview with someone from a small land-grant institution outside the continental United States was an outlier in that the survey questions did not apply to the work done at the institution. Therefore, this interview is not included in the discussion below.

1. Training of Domestic and International Students

Interviews indicate that, at the undergraduate level, most plant breeding students are domestic. Interviewees gave responses that indicate that plant breeding undergraduate programs have between 80–100% domestic students. At the graduate level, the most common response was a 50:50 split between domestic and international students, with medium land-grant institutions (both SAES and non-SAES) and large SAES institutions

[20] The difference in average salary may be higher than this because the average was calculated without weighting differences in organizational size. In the private sector, the companies that indicated salaries above $100,000 represent 235 employees, the companies that indicated salaries between $80,000 and $100,000 represent 436 employees, and the companies that indicated salaries below $80,000 represent 14 employees. This distribution suggests that the average starting salary in the private sector may be closer to $100,000.

reporting this ratio. One interviewee from a large SAES institution reported that while the ratio was historically 50:50, it has recently shifted to 65% domestic and 35% international. One respondent from a small, non-land-grant institution reported that PhD students were mostly domestic, and one respondent from a large SAES institution reported that the breeding program had mostly domestic students but the biotechnology program had a mix of domestic and international students.

This ratio of international students is lower than was previously reported by Guner and Wehner (2003). The decreased ratio of international to domestic graduate students may reflect an increased popularity of plant breeding domestically. Two interviewees indicated that more students have become interested in plant breeding in the past 10 years. The interviewee at the institution that has recently experienced a shift to more domestic PhD students reported two reasons for the shift: (1) fewer countries are sending students to the institution with financial support, and (2) granting agencies have shown greater recognition for plant breeding recently. Together these reasons have led to more competitive grants, and a need to pick the best graduate students. Because graduate program administrators are able to find out more information about domestic students than international students, they are better able to judge their qualifications, resulting in a higher acceptance rate of domestic graduate students compared with international graduate students.

2. Employment of Bachelor Degree Recipients

The dominant career path for undergraduate students in plant breeding-related majors is in industry, with most interviewees giving numbers between 50–75%. Within industry, graduates are employed by regional seed companies, chemical companies, and controlled environmental production companies, where they become agronomic or horticultural technical representatives, technicians for seed companies, or sales representatives. The majority of interviewees indicated that between 10% and 30% of students continue onto graduate school. One interviewee reported that 20% of students seek international experience following their undergraduate degree. Another interviewee reported an equal distribution of undergraduate degree-recipients as being employed by the government or the private sector or as going into graduate school.

3. Employment of PhD Graduates

Interviewees were asked where their plant breeding graduate students work after receiving their PhDs. One interviewee said that their program has had a 50:50 split between students going into private industry and students going into non-industry positions (which include academia, government, or non-governmental organizations). Another seven interviewees said that their PhD students predominately go into industry. One interviewee reported that the institution's graduate student population (both domestic and international students) had historically been split equally among three types of positions: one-third of

the population went to private seed companies in the United States, one-third went to the public sector (either USDA or academia), and one third went to international companies. Since 2008, the public sector has been hiring less and, as a result, 65% of graduate students go into private industry and 35% stay in either the domestic or international public sector.

In addition to greater job availability in the private sector, interviewees cited the following reasons for students going into industry: greater availability of resources, better technical support, better compensation, and lower teaching loads. One interviewee expressed concern about being able to attract the best applicants given that plant breeding research would not have a guaranteed funding base.

One interviewee mentioned that most students go on to jobs related to plant improvement for fuel, fiber, and food crops. While all of these students are hired into plant breeding positions, some fulfill job responsibilities similar to statisticians and data scientists. All of the students are taking on roles among a team of scientists doing cultivar development. This interviewee mentioned that the PhD students with strong statistical and data analytics skills are highly sought after by multiple sectors and some change fields and use these skills in medical disciplines. The interviewee thought that the compensation might be higher in medical fields compared to plant breeding.[21] Another interviewee said that better training in high-throughput sequencing, as well as data science and statistics skills, is needed within the field of plant breeding.

4. Funding for Graduate Students and Research

Funding resources varied among interviewees. Multiple interviewees mentioned commodity crop commissions and Federal grants as primary funding sources. Another interviewee said that a mixture of grants, royalties, and gifts from industry pay for research assistantships, and that a reduction in funding from any of these sources could reduce the number of research assistantships. This interviewee reported that a large percentage of faculty time is spent looking for funding.

One interviewee at an SAES institution said that crops that receive Federal commodity checkoff funds are able to support graduate students and keep a level of

[21] A group discussion held with current and former leadership from the National Association of Plant Breeders revealed that plant breeders get training in data analytics, which makes them applicable to jobs in medicine, engineering, and business. The discussants also mentioned that plant breeding companies cannot offer the same salaries that graduate students would make in medicine. The potential for graduate students to leave the field of plant breeding presents a risk for private industry companies that fund graduate students' education in plant breeding.

baseline funding available.[22] This interviewee stated that it is challenging to support research on crops that do not receive checkoff funds.

One interviewee said that funding sources were historically Hatch Act funding,[23] USDA competitive grants, and funding from growers groups, but that funding from growers groups has not kept up with the cost of research. This interviewee said that from the late 1980s to early 2010, there was no cultivar development focus from either USDA or the National Science Foundation (NSF). During this period, royalties from crop releases helped bridge the funding gap. Now, USDA and, to some extent, NSF are recognizing plant breeding within their competitive grants.

5. Other Issues

Interviewees mentioned additional issues in plant breeding, as described in the subsections that follow.

a. Hiring Issues

Multiple interviewees discussed problems in hiring plant breeders. One interviewee said that plant breeding is not as prestigious as basic plant research. Funding for plant breeding was discussed as a barrier to convincing universities to hire additional plant breeders. One interviewee said that if more funding were available for plant breeding, administrators would be more amenable to hiring plant breeders. Another interviewee expressed concern about not being able to attract the most qualified plant breeders to faculty positions due to a lack of guaranteed baseline funding for the crops that they would be hired to work on. The interviewee also mentioned that it is difficult to convince university administrators to hire plant breeders because curricula vitae of plant breeders show fewer publications than those of plant geneticists because seed releases are valued over publications as a metric of success within the plant breeding research community.

Multiple interviewees mentioned that there are now more jobs available in academia than have been available in the recent past. One interviewee said that this is due to a combination of improved State budgets, attrition through retirements, and tenured faculty going into the private sector. Another interviewee said that there is growing interest in some specialty crops, which is also fueling job availability.

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[22] Federal commodity checkoff programs, or research and promotion programs, promote or enhance commodities such as soybeans, milk, or beef. These programs are authorized by Congress and overseen by the Agricultural Marketing Service at USDA. In the case of soybeans, farmers contribute 0.5% of the price of each bushel at the first point of sale. A portion of those funds are used to fund soybean research.

[23] The Hatch Act of 1887 supports agricultural research at 1862 land-grant institutions and SAESs.

b. Research Infrastructure

Multiple interviewees brought up issues related to research infrastructure. One said that it is a challenge to keep up with physical asset costs and that the lack of maintenance of the research infrastructure is probably the greatest threat to plant breeding. Two others said that the resources and research infrastructure available within industry are a draw for PhDs when they are weighing whether to go into academia or industry.

c. Responsibility to the Community

Another issue that came up in interviews is the appropriate role of public sector plant breeders when a crop is dominated by private industry. One interviewee stated the opinion that the role of the public sector is not to do cultivar development but to develop new germplasm. Two different interviewees discussed the shrinking role of the public sector in corn and soybean breading, and a survey respondent said that cultivar development programs have stopped because "widespread use of commercially patented transgenic corn and soybeans has supplanted the role of public institutions in developing finished cultivars in these species." The change in the number of SPYs dedicated to corn and soybeans supports this claim.

One interviewee said that it is not clear what the public sector's role should be once the private sector has more profitable cultivar development programs. The interviewee posed three potential roles for the public sector in cultivar development: (1) continue cultivar development programs in case the industry fails, (2) continue cultivar development programs because the role of the public sector is educating the plant breeders that go into the private sector, or (3) cease cultivar development programs because they cannot compete with those of the private sector. The interviewee also mentioned that if the private sector produces hybrid wheat, it will potentially outcompete the public sector, which currently has large wheat efforts, particularly in the plains States. Another interviewee mentioned that the public sector can compete with the private sector with inbred crops, but that the private sector has an intellectual property advantage with hybrids. Given that wheat has more SPYs than any other crop in the public sector, the private sector's development of wheat strains that the public sector cannot compete with could have significant implications for the number of plant breeders in the public sector and the direction of their research, as well as for the training of students in plant breeding.

Appendix A.
Public Sector Survey Documentation

Survey Instrument

Purpose: The purpose of this survey is to better understand the current state of public sector cultivar development efforts, plant breeding education and training, and funding for plant breeding programs within your institution.

Time Needed: The amount of time needed to complete the survey will depend on whether you have the data needed to answer the questions easily accessible. If you currently have all the data needed, we estimate that the survey will take approximately an hour to complete.

Definitions:

Cultivar- A plant variety that has arisen or persists only in cultivation

Cultivar Development- Any activity of crossing, transformation, and/or selection among plants with the intention of releasing a crop variety.

Plant breeding- The human-aided development of new plant cultivars with needed characteristics

1) Is your contact information correct?

( ) Yes

( ) No

2) Please provide your contact information

Name: _____

Email Address: _____

Phone Number: _____

Organization: _____

3) Does your department have cultivar development efforts?

( ) Yes

( ) No

( ) I don't know

The following section asks questions related to cultivar development efforts at your institution. For your reference, we define science person year and cultivar development below.

Definitions:

Cultivar Development- Any activity of crossing, transformation, and/or selection among plants with the intention of releasing a crop variety.

Science Person Year- Work done by a person who has responsibility for designing, planning, administering (managing), and conducting cultivar development in one (1) year (i.e., 2,080 hours). DO NOT include technicians, farm and clerical workers, computer specialists, post docs, grad students, etc.

4) How many science person years are dedicated to the sub-classes of cultivars below? Please select the response that most closely matches your institution. If you do not know the answer, we request that you find out from your faculty/staff. Please do not guess the answer.

Please include only faculty/staff, including SAES faculty/staff.

DO NOT include technicians, farm and clerical workers, computer specialists, post docs, grad students, etc.

If faculty/staff member works on multiple crops, assume an equal amount of time distributed to each crop.

	0 Science Person Years	Between 0 and 1 Science Person Years	1 Science Person Years	2 Science Person Years	3 Science Person Years	4 Science Person Years	5 or more Science Person Years	I don't know
Agave	( )	( )	( )	( )	( )	( )	( )	( )
Almond	( )	( )	( )	( )	( )	( )	( )	( )
Apple	( )	( )	( )	( )	( )	( )	( )	( )
Apricot	( )	( )	( )	( )	( )	( )	( )	( )

Banana	( )	( )	( )	( )	( )	( )	( )	( )
Barley	( )	( )	( )	( )	( )	( )	( )	( )
Beans (dry)	( )	( )	( )	( )	( )	( )	( )	( )
Beans (fresh, fresh-processed)	( )	( )	( )	( )	( )	( )	( )	( )
Blueberry	( )	( )	( )	( )	( )	( )	( )	( )
Canola	( )	( )	( )	( )	( )	( )	( )	( )
Carrot	( )	( )	( )	( )	( )	( )	( )	( )
Cassava (or manioc)	( )	( )	( )	( )	( )	( )	( )	( )
Castor	( )	( )	( )	( )	( )	( )	( )	( )
Cherry	( )	( )	( )	( )	( )	( )	( )	( )
Chinese tallow	( )	( )	( )	( )	( )	( )	( )	( )
Coconut	( )	( )	( )	( )	( )	( )	( )	( )
Cole crops (includes cabbage, kale, broccoli, Brussels sprouts, cauliflower, kohlrabi)	( )	( )	( )	( )	( )	( )	( )	( )
Corn (not including sweetcorn)	( )	( )	( )	( )	( )	( )	( )	( )
Cotton, other	( )	( )	( )	( )	( )	( )	( )	( )

Cottonseed (for meal, oil, etc.)	( )	( )	( )	( )	( )	( )	( )	( )
Crambe	( )	( )	( )	( )	( )	( )	( )	( )
Cranberry	( )	( )	( )	( )	( )	( )	( )	( )
Cucumber	( )	( )	( )	( )	( )	( )	( )	( )
Cucurbits, other (includes pumpkin, squash, gourd)	( )	( )	( )	( )	( )	( )	( )	( )
Cuphea	( )	( )	( )	( )	( )	( )	( )	( )
Date	( )	( )	( )	( )	( )	( )	( )	( )
Durum wheat	( )	( )	( )	( )	( )	( )	( )	( )
Eggplant	( )	( )	( )	( )	( )	( )	( )	( )
Filbert	( )	( )	( )	( )	( )	( )	( )	( )
Flax	( )	( )	( )	( )	( )	( )	( )	( )
Grain sorghum	( )	( )	( )	( )	( )	( )	( )	( )
Grapefruit	( )	( )	( )	( )	( )	( )	( )	( )
Greens and leafy vegetables (includes endive, lettuce, spinach, turnip-greens, celery, rhubarb,	( )	( )	( )	( )	( )	( )	( )	( )

parsley, asparagus)								
Hard red spring wheat	( )	( )	( )	( )	( )	( )	( )	( )
Hard red winter wheat	( )	( )	( )	( )	( )	( )	( )	( )
Hard white wheat (includes club, western)	( )	( )	( )	( )	( )	( )	( )	( )
Hemp	( )	( )	( )	( )	( )	( )	( )	( )
Jojoba	( )	( )	( )	( )	( )	( )	( )	( )
Kenaf	( )	( )	( )	( )	( )	( )	( )	( )
Kiwi	( )	( )	( )	( )	( )	( )	( )	( )
Lemon	( )	( )	( )	( )	( )	( )	( )	( )
Lentil	( )	( )	( )	( )	( )	( )	( )	( )
Lesquerella	( )	( )	( )	( )	( )	( )	( )	( )
Long fiber cotton	( )	( )	( )	( )	( )	( )	( )	( )
Mango	( )	( )	( )	( )	( )	( )	( )	( )
Meadowfoam	( )	( )	( )	( )	( )	( )	( )	( )
Melons (includes cantaloupe, muskmelon, watermelon)	( )	( )	( )	( )	( )	( )	( )	( )
Mushrooms and other edible fungi	( )	( )	( )	( )	( )	( )	( )	( )

Nectarine	( )	( )	( )	( )	( )	( )	( )	( )
Oats	( )	( )	( )	( )	( )	( )	( )	( )
Onion, garlic, leek, shallot	( )	( )	( )	( )	( )	( )	( )	( )
Orange	( )	( )	( )	( )	( )	( )	( )	( )
Ornamentals and Turf	( )	( )	( )	( )	( )	( )	( )	( )
Palm	( )	( )	( )	( )	( )	( )	( )	( )
Papaya	( )	( )	( )	( )	( )	( )	( )	( )
Pasture and Forage Crops	( )	( )	( )	( )	( )	( )	( )	( )
Peach	( )	( )	( )	( )	( )	( )	( )	( )
Peanut	( )	( )	( )	( )	( )	( )	( )	( )
Pear	( )	( )	( )	( )	( )	( )	( )	( )
Peas (dry)	( )	( )	( )	( )	( )	( )	( )	( )
Peas (fresh, fresh-processed)	( )	( )	( )	( )	( )	( )	( )	( )
Pecan	( )	( )	( )	( )	( )	( )	( )	( )
Peppers	( )	( )	( )	( )	( )	( )	( )	( )
Pineapple	( )	( )	( )	( )	( )	( )	( )	( )
Plum	( )	( )	( )	( )	( )	( )	( )	( )
Popcorn	( )	( )	( )	( )	( )	( )	( )	( )
Potato	( )	( )	( )	( )	( )	( )	( )	( )

Raisin grapes	( )	( )	( )	( )	( )	( )	( )	( )
Ramie	( )	( )	( )	( )	( )	( )	( )	( )
Rape	( )	( )	( )	( )	( )	( )	( )	( )
Raspberry	( )	( )	( )	( )	( )	( )	( )	( )
Rice	( )	( )	( )	( )	( )	( )	( )	( )
Rye	( )	( )	( )	( )	( )	( )	( )	( )
Safflower	( )	( )	( )	( )	( )	( )	( )	( )
Sesame	( )	( )	( )	( )	( )	( )	( )	( )
Soft red wheat	( )	( )	( )	( )	( )	( )	( )	( )
Soft white wheat	( )	( )	( )	( )	( )	( )	( )	( )
Soybean	( )	( )	( )	( )	( )	( )	( )	( )
Strawberry	( )	( )	( )	( )	( )	( )	( )	( )
Sugar beet	( )	( )	( )	( )	( )	( )	( )	( )
Sugar cane	( )	( )	( )	( )	( )	( )	( )	( )
Sunflower	( )	( )	( )	( )	( )	( )	( )	( )
Sweet potato	( )	( )	( )	( )	( )	( )	( )	( )
Sweet sorghum	( )	( )	( )	( )	( )	( )	( )	( )
Sweetcorn	( )	( )	( )	( )	( )	( )	( )	( )
Table grapes	( )	( )	( )	( )	( )	( )	( )	( )

Taro	( )	( )	( )	( )	( )	( )	( )	( )
Tobacco	( )	( )	( )	( )	( )	( )	( )	( )
Tomato	( )	( )	( )	( )	( )	( )	( )	( )
Tung	( )	( )	( )	( )	( )	( )	( )	( )
Upland cotton	( )	( )	( )	( )	( )	( )	( )	( )
Walnut	( )	( )	( )	( )	( )	( )	( )	( )
Wine grapes	( )	( )	( )	( )	( )	( )	( )	( )
Yam	( )	( )	( )	( )	( )	( )	( )	( )

Comments:

5) Are there any cultivars that your institution has development programs for that you did not see represented in the questions above?

( ) Yes

( ) No

( ) I don't know

6) What additional cultivar development programs does your institution have?

	Cultivar Name	Number of Science Person Years						
		0 Science Person Years	Greater than 0 but less than 1 Science person Years	1 Science Person Years	2 Science Person Years	3 Science Person Years	4 Science Person Years	5 or more Science Person Years

Cultivar 1	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 2	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 3	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 4	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 5	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 6	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 7	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 8	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 9	___	( )	( )	( )	( )	( )	( )	( )
Cultivar 10	___	( )	( )	( )	( )	( )	( )	( )

Change in Science Person Years

7) Do you think that the number of Science Person Years devoted to cultivar development at your institution has changed over the past 10 years?

( ) Yes

( ) No

( ) I don't know

8) How has the number of Science Person Years devoted to cultivar development changed in the past 10 years?

( ) It increased

( ) It decreased

9) In the past 10 years, has your institution stopped any cultivar development programs?

( ) Yes

( ) No

( ) I don't know

10) What cultivar development programs stopped?

11) Why did those cultivar development programs stop?

12) Does your institution plan on hiring any additional faculty/staff to work on cultivar development in the next 12 months?

( ) Yes

( ) No

( ) I don't know

13) How many additional cultivar development faculty/staff do you plan to hire in the next 12 months? If you do not have access to the information required to answer this question, please leave it blank.

14) What is the typical starting salary for an assistant professor working on cultivar development at your institution?

( ) Under $60,000

( ) Between $60,000 and $80,000

( ) Between $80,000 and $100,000

( ) Between $100,000 and $120,000

( ) Above $120,000

( ) I don’t know

Online Education

15) Do you offer online plant breeding programs?

( ) Yes

( ) No

( ) I don't know

16) What is the name of the program(s)?

17) How many people are currently enrolled? If you do not have access to this information, please leave the question blank.

18) Does the combination of state and federal funding cover your institution's operating costs? We define the operating costs as the cost of resources used by your institution just to maintain its existence.

( ) Yes

( ) No

( ) I don't know

19) Indicate the percent of funding you receive from the following sources. If you do not have access to the data required to answer this question, please leave it blank.

_____Federal funds

_____State funds

_____Commodity crop organizations

_____Philanthropic organizations

_____Private industry

_____Other

20) Would you be willing to have brief follow-up on the phone for us to ask a few additional questions?

( ) Yes

( ) No

( ) I don't know

21) Are you ready to submit your answers?

( ) Yes, I would like to submit

( ) No, I would like to revisit the survey at a later time.

Institutions Surveyed

Table A-1 shows the institutions contacted with the public sector plant breeding survey and, if applicable, the specific department (or college, school, etc.).

Table A-1. Academic Institutions Contacted

Institution	Department
Alcorn State University	School of Agriculture, Research, Extension, and Applied Science (AREAS)-Department of Agriculture
Auburn University	Department of Crop, Soil and Environmental Sciences
Auburn University	Department of Horticulture
Brigham Young University	Orphaned Crops Lab
Central Lakes College, Staples Campus	Ag-Energy Center
Clemson University	College of Agriculture, Forestry and Life Sciences-Department of Agricultural and Environmental Sciences
Colorado State University	Soil and Crop Sciences
Connecticut Agricultural Experiment Station	—
Cornell University	School of Integrative Plant Science- Horticulture Section
Cornell University	Chair Plant Breeding and Genetics Section
Eastern Kentucky University	Department of Agriculture
Florida A&M University	College of Agriculture and Food Sciences- Division of Agriculture and natural Resources
Florida International University	Biology Department
Fort Valley State University	College of Agriculture, Family Sciences and Technology
Iowa State University	College of Agriculture and Life Sciences, Department of Agronomy
Kansas State University	Department of Agronomy
Langston University	Agriculture & Applied Sciences
Lincoln University	Department of Agriculture & Environmental Sciences
Louisiana State University	College of Agriculture- School of Plant, Environmental and Soil Sciences
Michigan State University	Department of Plant, Soil and Microbial Sciences
Mississippi State University	Department of Plant and Soil Sciences
New Mexico State University	Department of Plant and Environmental Sciences
North Carolina State University	College of Agriculture & Life Sciences, Department of Horticulture Science
North Dakota State University	Department of Plant Sciences
Northern Marianas College	Natural Resources Management
Oklahoma State University	Department of Plant and Soil Sciences
Oregon State University	Department of Horticulture
Oregon State University	ARS
Oregon State University	Crop and Soil Science
Pennsylvania State University	—

Institution	Department
Prairie View A&M University	College of Agriculture and Human Sciences, Cooperative Agricultural Research Center
Purdue University	Agriculture, Horticulture & Landscape Architecture
Purdue University	Agronomy
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology
South Dakota State University	College of Agriculture & Biological Sciences-Department of Plant Science
Southern Illinois University	College of Agricultural Sciences, Department of Plant, Soil, & Agricultural Systems
Texas A&M University	Department of Horticulture
Texas A&M University	Department of Soil and Crop Sciences
Texas Tech University	College of Agricultural Sciences and National Resources, Department of Plant & Soil Science
Truman State University	Agricultural Science
University of Alaska	Natural Resources, School of and Extension
University of Arkansas	Department of Crop, Soil, and Environmental Sciences
University of California, Davis	Center for Plant Breeding
University of California, Riverside	Department of Botany & Plant Sciences
University of Connecticut	College of Agriculture, Health and Natural Resources, Plant Science and Landscape Architecture
University of Delaware	Department of Plant and Soil Sciences
University of Florida	Institute of Food and Agricultural Sciences, Department of Agronomy
University of Florida	Institute of Food and Agricultural Sciences, Horticulture Sciences Department
University of Georgia	Department of Horticulture
University of Guam	College of Natural and Applied Sciences
University of Hawaii	Department of Tropical Plant & Soil Sciences
University of Idaho	Department of Plant, Soil and Entomological Sciences
University of Illinois	Department of Crop Sciences
University of Kentucky	Department of Crop and Soil Sciences
University of Kentucky	Department of Horticulture
University of Maine	College of Natural Sciences, Forestry, and Agriculture, Plant, Soil and Environmental Sciences
University of Maryland (at College Park)	Department of Plant Science and Landscape Architecture
University of Massachusetts, Amherst	—
University of Minnesota	Department of Agronomy and Plant Genetics
University of Minnesota	Department of Horticultural Science
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences
University of Nebraska	Department of Agronomy and Horticulture
University of Nevada, Reno	Nevada Agricultural Experiment Station
University of Rhode Island	Department of Plant Sciences and Entomology
University of Tennessee (Knoxville)	College of Agricultural Sciences and Natural Resources, Department of Plant Sciences

Institution	Department
University of Tennessee (Martin)	Agriculture, GeoSciences, and Natural Resources
University of Vermont	College of Agriculture and Life Sciences
University of Wisconsin, Madison	Department of Horticulture (ARS contact)
University of Wisconsin, Madison	Department of Horticulture (university contact)
University of Wisconsin, Madison	Department of Agronomy
University of Wisconsin, River Falls	College of Agriculture, Food and Environmental Sciences
Utah State University	Agricultural Sciences
Virginia Polytechnic Institute & State University	Department of Horticulture
Virginia Polytechnic Institute & State University	Department of Crop & Soil Environmental Sciences
Virginia State University	College of Agriculture
Washington State University	Department of Crop and Soil Sciences
Washington State University	Department of Horticulture
West Texas A&M University	Department of Agricultural Sciences
West Virginia State University	Biology
West Virginia University	College of Agriculture, Natural Resources and Design, Division of Plant and Soil Sciences
Western Illinois University	School of Agriculture
Florida A&M University	Center for Viticulture and Small Fruit Research
Michigan Technological University	Biological Sciences
Alabama A&M University	College of Agricultural, Life, and Natural Sciences, Department of Biological and Environmental Sciences
American Samoa Community College	Agriculture
Community College of Micronesia	Agriculture
Delaware Valley College	Department of Plant Science
Duke University	Department of Biology
Kentucky State University	College of Agriculture, Food Science, and Sustainable Systems
Missouri State University	William H. Darr School of Agriculture
North Carolina A&T State University	Department of Natural Resources and Environmental Design
Ohio State University	College of Food, Agricultural, and Environmental Sciences, Department of Horticulture and Crop Science
Tennessee State University	Department of Agricultural & Environmental Sciences
Tufts University	Department of Biology
Tuskegee University	College of Agriculture Environment and Nutrition Sciences
United Tribes Technical College	Tribal Environmental Science
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences
University of Arkansas at Pine Bluff	School of Agriculture, Fisheries and Human Sciences
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture
University of Minnesota	Department of Plant Biology

Institution	Department
University of New Hampshire	Department of Biological Sciences
University of Puerto Rico	College of Agricultural Sciences
University of Wyoming	Department of Plant Sciences
White Earth Tribal and Community College	—
University of Georgia	College of Agricultural and Environmental Sciences, Crop and Soil Science
Stephen F. Austin State University	Arthur Temple College of Forestry and Agriculture
Montana State University	College of Agriculture- Department of Plant Sciences & Plant Pathology

The number of Science Person Years (SPYs) per crop is calculated from the survey results in Table A-2. A response of "between 0 and 1 SPYs" is estimated as 0.5. A response of "greater than 5 SPYs" is estimated as 5. In some cases, respondents wrote in specific crops that belong in a larger category already listed in the survey instrument. For this reason, certain crop categories (greens and leafy vegetables, ornamentals and turf, and pasture and forage crops) have a row indicated "total." These rows show the total number of SPYs summed from the general category listed in the survey instrument and the crops that were written in by respondents. Grapes and wheat are also given totals that summarize the number of SPYs for specific crops within those categories.

Table A-2. Number of Science Person Years (SPYs) per Crop from the Public Sector

Crop	Estimated Total SPYs	Notes
Agave	0.0	—
Almond	0.5	1 respondent reports between 0 and 1 SPYs
Alternative crops	0.5	1 respondent reports between 0 and 1 SPYs
Apple	11.0	6 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY, 1 respondent reports 2 SPYs, 1 respondent reports 5+ SPYs
Apricot	1.5	3 respondents report between 0 and 1 SPYs
Avocado	2.0	1 respondent reports 2 SPYs
Banana	2.0	4 respondents report between 0 and 1 SPYs
Barley	13.0	8 respondents report between 0 and 1 SPYs, 4 respondents report 1 SPY, 1 respondent reports 5+ SPYs
Basil	0.5	1 respondent reports between 0 and 1 SPYs
Beans (dry)	10.5	9 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 2 respondents report 2 SPYs
Beans (fresh, fresh-processed)	7.5	7 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY, 1 respondent reports 3 SPYs
Biomass sorghum	1.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 1 SPY
Blackberry	1.0	2 respondents report between 0 and 1 SPYs
Blueberry	9.5	5 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 5+ SPYs
Bread fruit	2.0	1 respondent reports 2 SPYs
Canola	5.5	3 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 2 SPYs

Crop	Estimated Total SPYs	Notes
Carrot	1.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 1 SPY
Cassava (or manioc)	1.0	2 respondents report between 0 and 1 SPYs
Castor	0.5	1 respondent reports between 0 and 1 SPYs
Catnip	0.5	1 respondent reports between 0 and 1 SPYs
Cherry	7.5	3 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY, 1 respondent reports 5+ SPYs
Chickpeas	0.5	1 respondent reports between 0 and 1 SPYs
Chinese tallow	0.5	1 respondent reports between 0 and 1 SPYs
Coconut	0.5	1 respondent reports between 0 and 1 SPYs
Cole crops	3.5	7 respondents report between 0 and 1 SPYs
Cordgrass	0.5	1 respondent reports between 0 and 1 SPYs
Corn (not including sweetcorn)	24.0	10 respondents report between 0 and 1 SPYs, 5 respondents report 1 SPY, 3 respondents report 2 SPYs, 1 respondent reports 3 SPYs, 1 respondent reports 5+ SPYs
Cotton, other	11.5	3 respondents report between 0 and 1 SPYs, 2 respondents report 5+ SPYs
Cottonseed (for meal, oil, etc.)	1.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 1 SPY
Cowpea	2.0	2 respondents report 1 SPY
Crambe	0.5	1 respondent reports between 0 and 1 SPYs
Cranberry	3.0	2 respondents report between 0 and 1 SPYs, 1 respondent reports 2 SPYs
Cucumber	2.5	5 respondents report between 0 and 1 SPYs
Cucurbits—Squash	0.5	1 respondent reports between 0 and 1 SPYs
Cucurbits, other (includes pumpkin, squash, gourd)	5.0	8 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Cuphea	0.5	1 respondent reports between 0 and 1 SPYs
Date	0.0	—
Dragon fruit	2.0	1 respondent reports 2 SPYs
Eggplant	1.0	2 respondents report between 0 and 1 SPYs
Field pennycress	1.0	2 respondents report between 0 and 1 SPYs
Fig	0.5	1 respondent reports between 0 and 1 SPYs
Filbert	1.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 1 SPY
Flax	1.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 1 SPY
Grain sorghum	11.5	3 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY, 3 respondents report 3 SPYs

Crop	Estimated Total SPYs	Notes
Grapefruit	3.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 3 SPYs
Grapes—muscadines	0.5	1 respondent reports between 0 and 1 SPYs
Grapes—raisin grapes	1.0	2 respondents report between 0 and 1 SPYs
Grapes—table grapes	5.5	7 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY
Grapes—wine grapes	10.0	8 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 2 respondents report 2 SPYs
Grapes total	17.0	18 respondents report between 0 and 1 SPYs, 4 respondents report 1 SPY, 2 respondents report 2 SPYs
Greens and leafy vegetables—asparagus	0.5	1 respondent reports between 0 and 1 SPYs
Greens and leafy vegetables—fiddlehead ferns	0.5	1 respondent reports between 0 and 1 SPYs
Greens and leafy vegetables	8.5	5 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY, 1 respondent reports 2 SPYs, 1 respondent reports 3 SPYs
Greens and leafy vegetables total	9.5	7 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY, 1 respondent reports 2 SPYs, 1 respondent reports 3 SPYs
Guayule	0.5	1 respondent reports between 0 and 1 SPYs
Hazelnuts	0.5	1 respondent reports between 0 and 1 SPYs
Hemp	1.0	2 respondents report between 0 and 1 SPYs
Hop	1.0	1 respondent reports 1 SPY
Jojoba	0.0	—
Kenaf	0.5	1 respondent reports between 0 and 1 SPYs
Kiwi	1.5	3 respondents report between 0 and 1 SPYs
Lemon	2.5	3 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Lentil	1.0	2 respondents report between 0 and 1 SPYs
Lesquerella	0.0	—
Long fiber cotton	2.0	2 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Mandarin	1.0	1 respondent reports 1 SPY
Mango	2.5	3 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Mayhaw	0.5	1 respondent reports between 0 and 1 SPYs
Meadowfoam	0.5	1 respondent reports between 0 and 1 SPYs
Melons	5.0	10 respondents report between 0 and 1 SPYs
Millet	1.0	1 respondent reports 1 SPY

Crop	Estimated Total SPYs	Notes
Mushrooms and other edible fungi	0.0	—
Nectarine	1.5	3 respondents report between 0 and 1 SPYs
Oats	8.5	11 respondents report between 0 and 1 SPYs, 3 respondents report 1 SPY
Okra	0.5	1 respondent reports between 0 and 1 SPYs
Onion, garlic, leek, shallot	2.0	2 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Orange	8.5	3 respondents report between 0 and 1 SPYs, 1 respondent reports 7 SPYs
Ornamentals—bermudagrass	1.0	1 respondent reports 1 SPY
Ornamentals—nursery—landscape plants	0.5	1 respondent reports between 0 and 1 SPYs
Ornamentals and turf—Dogwood	0.5	1 respondent reports between 0 and 1 SPYs
Ornamentals and turf—Herbaceous ornamental plants	0.5	1 respondent reports between 0 and 1 SPYs
Ornamentals and turf—Miscanthus	1.0	1 respondent reports 1 SPY
Ornamentals and turf—nitrogen-fixing trees (Leucaena, Acacia koa)	0.5	1 respondent reports between 0 and 1 SPYs
Ornamentals and turf—oak	0.5	1 respondent reports between 0 and 1 SPYs
Ornamentals and turf—woody plants	1.5	1 respondent reports between 0 and 1 SPYs, 1 respondent reports 1 SPY
Ornamentals and turf total	32.0	16 respondents report between 0 and 1 SPYs, 8 respondents report 1 SPY, 2 respondents report 2 SPYs, 1 respondent reports 3 SPYs, 1 respondent reports 4 SPYs, 1 respondent reports 5+ SPYs
Ornamentals and Turf	25.0	10 respondents report between 0 and 1 SPYs, 4 respondents report 1 SPY, 2 respondents report 2 SPYs, 1 respondent reports 3 SPYs, 1 respondent reports 4 SPYs, 1 respondent reports 5+ SPYs
Ornamentals and Turf—Shrub willow	1.0	1 respondent reports 1 SPY
Palm	0.5	1 respondent reports between 0 and 1 SPYs
Papaya	3.5	3 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY
Pasture and forage—birdfoot trefoil	0.5	1 respondent reports between 0 and 1 SPYs
Pasture and forage—elephant grass	0.5	1 respondent reports between 0 and 1 SPYs
Pasture and forage—field radishes	0.5	1 respondent reports between 0 and 1 SPYs

Crop	Estimated Total SPYs	Notes
Pasture and forage—hairy vetch	0.5	1 respondent reports between 0 and 1 SPYs
Pasture and forage—switchgrass	1.0	2 respondents report between 0 and 1 SPYs
Pasture and forage crops	17.5	13 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 2 respondents report 2 SPYs, 1 respondent reports 5+ SPYs
Pasture and forage crops total	20.5	19 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 2 respondents report 2 SPYs, 1 respondent reports 5+ SPYs
Paw paw	0.5	1 respondent reports between 0 and 1 SPYs
Peach	8.0	6 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 3 SPYs
Peanut	8.0	2 respondents report between 0 and 1 SPYs, 3 respondents report 1 SPY, 1 respondent reports 4 SPYs
Pear	2.0	4 respondents report between 0 and 1 SPYs
Peas (dry)	6.0	4 respondents report between 0 and 1 SPYs, 1 respondent reports 4 SPYs
Peas (fresh, fresh-processed)	1.0	2 respondents report between 0 and 1 SPYs
Pecan	1.5	3 respondents report between 0 and 1 SPYs
Peppers	6.0	10 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Perennial sunflower	0.5	1 respondent reports between 0 and 1 SPYs
Pigeon peas	0.5	1 respondent reports between 0 and 1 SPYs
Pineapple	0.5	1 respondent reports between 0 and 1 SPYs
Pistachio	1.0	1 respondent reports 1 SPY
Plum	3.5	5 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Popcorn	1.5	3 respondents report between 0 and 1 SPYs
Poplar	0.5	1 respondent reports between 0 and 1 SPYs
Potato	15.0	4 respondents report between 0 and 1 SPYs, 5 respondents report 1 SPY, 1 respondent reports 2 SPYs, 2 respondents report 3 SPYs
Quinoa	2.0	1 respondent reports 2 SPYs
Ramie	0.0	—
Rape	0.5	1 respondent reports between 0 and 1 SPYs
Raspberry	5.0	4 respondents report between 0 and 1 SPYs, 1 respondent reports 3 SPYs
Rice	13.0	2 respondents report between 0 and 1 SPYs, 1 respondent reports 3 SPYs, 1 respondent reports 4 SPYs, 1 respondent reports 5+ SPYs

Crop	Estimated Total SPYs	Notes
Rye	1.5	3 respondents report between 0 and 1 SPYs
Safflower	0.5	1 respondent reports between 0 and 1 SPYs
Sesame	0.5	1 respondent reports between 0 and 1 SPYs
Silphium	0.5	1 respondent reports between 0 and 1 SPYs
Sorghum (unspecified)	1.0	2 respondents report between 0 and 1 SPYs
Soybean	23.5	7 respondents report between 0 and 1 SPYs, 6 respondents report 1 SPY, 7 respondents report 2 SPYs
Strawberry	10.0	8 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 4 SPYs
Sugar beet	1.0	1 respondent reports 1 SPY
Sugar cane	7.0	2 respondents report between 0 and 1 SPYs, 3 respondents report 2 SPYs
Sunflower	2.0	4 respondents report between 0 and 1 SPYs
Sweet potato	9.0	4 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 5+ SPYs
Sweet sorghum	4.0	8 respondents report between 0 and 1 SPYs
Sweetcorn	6.5	5 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 2 SPYs
Table beet	0.5	1 respondent reports between 0 and 1 SPYs
Taro	1.5	3 respondents report between 0 and 1 SPYs
Tobacco	2.0	4 respondents report between 0 and 1 SPYs
Tomato	11.5	7 respondents report between 0 and 1 SPYs, 4 respondents report 1 SPY, 1 respondent reports 4 SPYs
Tung	0.5	1 respondent reports between 0 and 1 SPYs
Upland cotton	3.5	5 respondents report between 0 and 1 SPYs, 1 respondent reports 1 SPY
Walnut	1.0	1 respondent reports 1 SPY
Wheat—durum wheat	3.5	3 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY
Wheat—hard red spring wheat	8.5	9 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 1 respondent reports 2 SPYs
Wheat—hard red winter wheat	17.5	7 respondents report between 0 and 1 SPYs, 4 respondents report 1 SPY, 3 respondents report 2 SPYs, 1 respondent reports 4 SPYs
Wheat—hard white wheat (includes club, western)	5.5	5 respondents report between 0 and 1 SPYs, 3 respondents report 1 SPY

Crop	Estimated Total SPYs	Notes
Wheat—intermediate wheatgrass	0.5	1 respondent reports between 0 and 1 SPYs
Wheat—soft red wheat	11.5	11 respondents report between 0 and 1 SPYs, 2 respondents report 1 SPY, 2 respondents report 2 SPYs
Wheat—soft white wheat	9.0	8 respondents report between 0 and 1 SPYs, 1 respondent reports 5+ SPYs
Wheat total	56.0	44 respondents report between 0 and 1 SPYs, 13 respondents report 1 SPY, 6 respondents report 2 SPYs, 1 respondent reports 4 SPYs, 1 respondent reports 5+ SPYs
Wheat relatives (emmer, einkorn, spelt)	0.5	1 respondent reports between 0 and 1 SPYs
Wild rice	0.5	1 respondent reports between 0 and 1 SPYs
Winter barley	0.5	1 respondent reports between 0 and 1 SPYs
Yam	0.5	1 respondent reports between 0 and 1 SPYs

Table A-3 was created by looking through the faculty websites for institutions listed in Table A-1. If a faculty member was listed in a relevant department but their website did not indicate the crops that they work on, the crop is listed as “unclear.” Assistant, associate, and full professors are listed as “Faculty,” under the heading “Position”; otherwise, the faculty member’s position title is listed.

Table A-3. Plant Breeding Faculty Information

Institution	Department	Name	Position	Crop
Alabama A&M University	Biological and Environmental Sciences	Khairy M. Soliman	Faculty	Cotton, soybean
Alabama A&M University	Biological and Environmental Sciences	Srinivasa Rao Mentreddy	Faculty	Medicinal plants with hypoglycemic/ antihyperglycemic properties
Alabama A&M University	Biological and Environmental Sciences	Rufina Ward	Faculty	Unclear
Alabama A&M University	Biological and Environmental Sciences	Leopold M. Nyochembeng	Faculty	Vegetable crops/ mushrooms
Alabama A&M University	Biological and Environmental Sciences	Ernst Cebert	Faculty	Winter canola
Alcorn State University	Center for Biotechnology and Genomics	Victor Njiti	Faculty	Unclear
Alcorn State University	Center for Biotechnology and Genomics	Chunquan Zhang	Faculty	Unclear
Alcorn State University	Center for Biotechnology and Genomics	Qun Xia	Faculty	Unclear
Alcorn State University	Center for Biotechnology and Genomics	Yan Meng	Faculty	Unclear
American Samoa Community College	—	Ian Gurr	Faculty	Unclear
Auburn University	Department of Crop, Soil and Environmental Sciences	Charles Y. Chen	Faculty	Peanut
Auburn University	Department of Crop, Soil and Environmental Sciences	David B. Weaver	Faculty	Soybean/cotton
Auburn University	Department of Crop, Soil and Environmental Sciences	Edzard van Santen	Faculty	Unclear
Brigham Young University	Plant and Wildlife Sciences	Joshua Udall	Faculty	Cotton
Brigham Young University	Plant and Wildlife Sciences	Jeff Maughan	Faculty	Orphan crops: quinoa, amaranth, oca
Brigham Young University	Plant and Wildlife Sciences	Brad Geary	Faculty	Potato, quinoa
Brigham Young University	Plant and Wildlife Sciences	Craig Coleman	Faculty	Quinoa
Brigham Young University	Plant and Wildlife Sciences	Rick Jellen	Faculty	Quinoa, amaranth, kiwicha

Institution	Department	Name	Position	Crop
Brigham Young University	Plant and Wildlife Sciences	Mikel Stevens	Faculty	Tomato, quinoa
Brigham Young University	Orphaned Crops Lab	Eric Jellen	Faculty	Oat, quinoa
Brigham Young University	Orphaned Crops Lab	Jeff Maughan	Faculty	Orphan crops: quinoa, amaranth, oca
Brigham Young University	Department of Plant and Wildlife Sciences	Mikel Stevens	Faculty	Unclear
Brigham Young University	Department of Plant and Wildlife Sciences	Joshua Udall	Faculty	Unclear
Central Lakes College	Ag-Energy Center	Keith Olander Associate Dean of Agriculture (can't find any faculty doing the research)	Faculty	Sunflowers
Clemson University	School of Agricultural, Forest, and Environmental Sciences	Gasic Ksenija	Faculty	Peach
Clemson University	School of Agricultural, Forest, and Environmental Sciences	Gregory Reighard	Faculty	Prunus
Clemson University	School of Agricultural, Forest, and Environmental Sciences	Jeff Adelberg	Faculty	Unclear
Colorado State University	Department of Soil and Crop Sciences	Mark Brick	Faculty	Dry bean
Colorado State University	Department of Soil and Crop Sciences	Jerry Johnson	Faculty	Oilseeds, other crops
Colorado State University	San Luis Valley Research Center	David G. Holm	Faculty	Potato
Colorado State University	Department of Soil and Crop Sciences	Patrick Byrne	Faculty	Wheat, dry beans
Colorado State University	Department of Soil and Crop Sciences	Scott Haley	Faculty	Wheat
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Susan Brown	Associate Dean CALS and Director NYSAES Professor	Apple
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Phillip Griffiths	Faculty	Bean, tomato

Institution	Department	Name	Position	Crop
Cornell	School of Integrative Plant Science, Horticulture	Courtney Weber	Faculty	Berries
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Margaret Smith	Faculty	Corn
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Bruce Reisch	Faculty	Grape
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Jeff J. Doyle	Faculty	Legumes
Cornell	School of Integrative Plant Science. Plant Breeding and Genetics	Tim Setter	Faculty	Maize, wheat
Cornell	School of Integrative Plant Science, Horticulture	Mark Bridgen	Professor Director, Long Island Horti-cultural Research and Extension Center	Ornamental
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Donald Viands	Faculty	Perennial forage plants
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Walter De Jong	Faculty	Potato
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Ronnie Coffman	Faculty	Rice
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Susan McCouch	Faculty	Rice
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Lawrence Smart	Faculty	Shrub willow bioenergy crops
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Susheng Gan	Faculty	Unclear
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Michael Gore	Faculty	Unclear

Institution	Department	Name	Position	Crop
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Rebecca Nelson	Faculty	Unclear
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Mark Sorrells	Faculty	Unclear
Cornell	School of Integrative Plant Science, Horticulture	Mark Bridgen	Professor, Director of Long Island Research Horti-cultural Research and Extension Center	Unclear
Cornell	School of Integrative Plant Science, Horticulture	Gennaro Fazio	Adjunct Associate Professor	Unclear
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Matthew Blair	Adjunct Professor	Unclear
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Hale Ann Tufan	Faculty	Unclear
Cornell	School of Integrative Plant Science, Horticulture	Nina Bassuk	Faculty	Urban plants
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Michael Mazourek	Faculty	Vegetables
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Martha Mutschler-Chu	Faculty	Vegetables
Cornell	School of Integrative Plant Science, Plant Breeding and Genetics	Jessica Rutkoski	Faculty	Wheat
Delaware State University	College of Agriculture & Related Sciences	Venu Kalavacharla	Faculty	Common bean
Delaware State University	College of Agriculture & Related Sciences	Cyril Broderick	Faculty	Soybean, winter squash, Hevea rubber, okra, eggplant, peppers, and tomatoes
Duke	Biology	Thomas Mitchell-Olds	Faculty	Rice

Institution	Department	Name	Position	Crop
Duke	Genetics	Tai-Ping Sun	Faculty	Rice
Duke	Genetics	John H Willis	Faculty	Unclear
Florida International University	Botany	Eric Von Wettberg Bishop	Faculty	Chickpea
Fort Valley State University	College of Agriculture, Family Sciences, and Technology	Bipul Biswas	Faculty	Unclear
Fort Valley State University	College of Agriculture, Family Sciences, and Technology	Nirmal Joshee	Faculty	Unclear
Iowa State University	Department of Agronomy	Kan Wang	Faculty	Corn, soybean, rice
Iowa State University	Department of Agronomy	Jode Edwards	Faculty	Maize
Iowa State University	Department of Agronomy	Patrick Schnable	Faculty	Maize
Iowa State University	Department of Agronomy	Paul Scott	Faculty	Maize
Iowa State University	Department of Agronomy	Jianming Yu	Faculty	Maize
Iowa State University	Department of Agronomy	Michael Lee	Faculty	Maize, oat
Iowa State University	Department of Agronomy	Maria Salas Fernandez	Faculty	Sorghum
Iowa State University	Department of Agronomy	Madan Bhattacharyya	Faculty	Soybean
Iowa State University	Department of Agronomy	Silvia Cianzio	Faculty	Soybean
Iowa State University	Department of Agronomy	Walter Fehr	Faculty	Soybean
Iowa State University	Department of Agronomy	R. Shoemaker	Faculty	Soybean
Iowa State University	Department of Agronomy	Asheesh Singh	Faculty	Soybean
Iowa State University	Department of Agronomy	Arti Singh	Adjunct Assistant Professor	Soybean
Iowa State University	Department of Agronomy	Steven Cannon	Faculty	Soybean and other legumes
Iowa State University	Department of Agronomy	Jessica Barb	Adjunct Assistant Professor	Sunflowers
Iowa State University	Department of Agronomy	Shui-zhang Fei	Faculty	Turfgrass

Institution	Department	Name	Position	Crop
Iowa State University	Department of Agronomy	William Beavis	Faculty	Unclear
Iowa State University	Department of Agronomy	Philip Becraft	Faculty	Unclear
Iowa State University	Department of Agronomy	Candice Gardner	Faculty	Unclear
Iowa State University	Department of Agronomy	Michelle Graham	Faculty	Unclear
Iowa State University	Department of Agronomy	David Grant	Faculty	Unclear
Iowa State University	Department of Agronomy	Kendall Lamkey	Faculty	Unclear
Iowa State University	Department of Agronomy	Thomas Lubberstedt	Faculty	Unclear
Iowa State University	Department of Agronomy	C. Lawrence	Faculty	Unclear
Iowa State University	Department of Agronomy	Thomas Peterson	Faculty	Unclear
Iowa State University	Department of Agronomy	M. Widrlechner	Faculty	Unclear
Kansas State University	Department of Agronomy	Tesfaye Tesso	Faculty	Sorghum
Kansas State University	Department of Agronomy	Ramasamy Perumal	Faculty	Sorghum
Kansas State University	Department of Agronomy	Geoffrey Morris	Faculty	Sorghum
Kansas State University	Department of Agronomy	William Schapaugh	Faculty	Soybean
Kansas State University	Department of Agronomy	Allan Fritz	Faculty	Wheat
Kansas State University	Department of Agronomy	Guorong Zhang	Faculty	Wheat
Kansas State University	Department of Agronomy	Guihua Bai	Faculty	Wheat
Lincoln University	Department of Agriculture and Environmental Sciences	Safiullah Pathan	Faculty	Soybean
Louisiana State University	School of Plant, Environmental & Soil Sciences	Jeff Kuehny	Faculty	Chrysanthemum
Louisiana State University	School of Plant, Environmental & Soil Sciences	Collins Kimbeng	Faculty	Cotton

Institution	Department	Name	Position	Crop
Louisiana State University	School of Plant, Environmental & Soil Sciences	Gary Breitenbeck	Faculty	Cotton
Louisiana State University	School of Plant, Environmental & Soil Sciences	Charles Johnson	Faculty	Peach
Louisiana State University	School of Plant, Environmental & Soil Sciences	Gerald Myers	Faculty	Rice
Louisiana State University	School of Plant, Environmental & Soil Sciences	James Oard	Faculty	Rice
Louisiana State University	School of Plant, Environmental & Soil Sciences	Prasanta Subudhi	Faculty	Rice, corn
Louisiana State University	School of Plant, Environmental & Soil Sciences	Lewis Gaston	Faculty	Soybean
Louisiana State University	School of Plant, Environmental & Soil Sciences	James Board	Faculty	Soybean
Louisiana State University	School of Plant, Environmental & Soil Sciences	Carrie Knott	Faculty	*Spartina alterniflora*, *Uniola paniculata*, and *Schoenoplectus californicus* clones and varieties
Louisiana State University	School of Plant, Environmental & Soil Sciences	Don Labonte	Faculty	Sweet potato
Louisiana State University	School of Plant, Environmental & Soil Sciences	Stephen Harrison	Faculty	Wheat, oat, marshgrass
Michigan State University	Department of Horticulture	Jim Hancock	Faculty	Blueberry, strawberry
Michigan State University	Department of Plant, Soil and Microbial Sciences	Karen Cichy	Adjunct USDA Assistant Professor	Dry bean
Michigan State University	Department of Plant, Soil and Microbial Sciences	James Kelly	Faculty	Dry bean
Michigan State University	Department of Plant, Soil and Microbial Sciences	David Douches	Faculty	Potato
Michigan State University	Department of Horticulture	Amy Lezzoni	Faculty	Sour cherry

Institution	Department	Name	Position	Crop
Michigan State University	Department of Plant, Soil and Microbial Sciences	Dechun Wang	Faculty	Soybean
Michigan State University	Department of Plant, Soil and Microbial Sciences	Mitch McGrath	Faculty	Sugar beet
Michigan State University	Department of Plant, Soil and Microbial Sciences	Joseph Vargas	Faculty	Turfgrass disease
Michigan State University	Department of Horticulture	Guo-Qing Song	Faculty	Unclear
Michigan State University	Department of Horticulture	Ryan Warner	Faculty	Unclear
Michigan State University	Department of Plant, Soil and Microbial Sciences	Eric Olson	Faculty	Wheat
Michigan Tech	Biological Sciences	Ramakrishna Wusirika	Faculty	Rice
Mississippi State University	Department of Plant and Soil Sciences	Brian Baldwin	Faculty	Bioenergy crops
Mississippi State University	Department of Plant and Soil Sciences	Rocky Lemus	Faculty	Bioenergy crops
Mississippi State University	Department of Plant and Soil Sciences	Bisoondat Macoon	Faculty	Bioenergy crops
Mississippi State University	Department of Plant and Soil Sciences	Brett Rushing	Faculty	Bioenergy crops
Mississippi State University	Department of Plant and Soil Sciences	Jac Varco	Faculty	Bioenergy crops
Mississippi State University	Department of Plant and Soil Sciences	Ted Wallace	Faculty	Cotton
Mississippi State University	Department of Plant and Soil Sciences	Ed Redona	Faculty	Rice
Mississippi State University	Department of Plant and Soil Sciences	Christian Baldwin	Faculty	Turfgrass
Mississippi State University	Department of Plant and Soil Sciences	Barry Stewart	Faculty	Turfgrass
Mississippi State University	Department of Plant and Soil Sciences	Richard Harkess	Faculty	Unclear
Missouri State University	William H. Darr School of Agriculture	Chin-Feng Hwang	Faculty	Grape
Missouri State University	William H. Darr School of Agriculture	Karl Wilker	Faculty	Grape
Missouri State University	William H. Darr School of Agriculture	Wenping Qiu	Faculty	Grape

Institution	Department	Name	Position	Crop
Montana State University	College of Agriculture, Plant Sciences & Plant Pathology	Tom Blake	Faculty	Barley
Montana State University	College of Agriculture, Plant Sciences & Plant Pathology	Jack martin	Faculty	Unclear
Montana State University	College of Agriculture, Plant Sciences & Plant Pathology	Phil Bruckner	Faculty	Viburnum
Montana State University	College of Agriculture, Plant Sciences & Plant Pathology	Luther Talbert	Faculty	Wheat
Montana State University	College of Agriculture, Plant Sciences & Plant Pathology	Mike Giroux	Faculty	Wheat, barley
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Ian Ray	Faculty	Alfalfa
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Paul Bosland	Faculty	Chile
New Mexico State University	Leyendecker Plant Science Center	Danise Coon	Faculty	Chile
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Jinfa Zhang	Faculty	Cotton
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Kevin Lombard	Faculty	Grape
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Richard Pratt	Faculty	Maize
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Christopher Cramer	Faculty	Onion
New Mexico State University	College of Agricultural, Consumer, and Environmental Sciences	Naveen Puppala	Faculty	Peanut
North Carolina A&T State University	Alrgn Bio (spin-off company)	Jianmei Yu	Faculty	Peanut
North Carolina A&T State University	Alrgn Bio (spin-off company)	Ann Russell	Faculty	Peanut
North Carolina A&T State University	The Cooperative Extension Program	Sanjun Gu	Faculty	Unclear

Institution	Department	Name	Position	Crop
North Carolina State University	Department of Horticultural Science	Julia L. Kornegay	Faculty	Annual and herbaceous perennials
North Carolina State University	Department of Horticultural Science	Hamid Ashrafi	Faculty	Blueberry
North Carolina State University	Department of Horticultural Science	Sara Spayed	Faculty	Bunch grape, wine grapes
North Carolina State University	Department of Horticultural Science	Todd Wehner	Faculty	Cucurbits
North Carolina State University	Department of Horticultural Science	John Dole	Faculty	Floricultural crops
North Carolina State University	Department of Horticultural Science	Mark Clough	Faculty	Potato
North Carolina State University	Department of Horticultural Science	Gina E. Fernandez	Faculty	Raspberry, blackberry
North Carolina State University	Department of Horticultural Science	Jeanine Davis	Faculty	Specialty crops (mushrooms, hops, truffles)
North Carolina State University	Department of Horticultural Science	Craig Yencho	Faculty	Sweet potato
North Carolina State University	Department of Horticultural Science	Dilip Panthee	Faculty	Tomato
North Carolina State University	Department of Horticultural Science	Michael Parker	Faculty	Tree fruit
North Carolina State University	Department of Horticultural Science	John Williamson	Faculty	Unclear
North Carolina State University	Department of Horticultural Science	Thomas Ranney	Faculty	Woody ornamentals
North Carolina State University	Department of Horticultural Science	Dennis Werner	Faculty	Woody ornamentals
North Dakota State University	Department of Plant Sciences	Marisol Berti	Faculty	Alfalfa, other forages/biomass crops
North Dakota State University	Department of Plant Sciences	Richard Horsley	Faculty	Barley
North Dakota State University	Department of Plant Sciences	Mukhlesur Rahman	Faculty	Canola
North Dakota State University	Department of Plant Sciences	Marcelo Carena	Faculty	Corn
North Dakota State University	Department of Plant Sciences	Juan Osorno	Faculty	Dry bean
North Dakota State University	Department of Plant Sciences	Kenneth Grafton	Faculty	Dry bean
North Dakota State University	Department of Plant Sciences	Elias M. Elias	Faculty	Durum wheat

Institution	Department	Name	Position	Crop
North Dakota State University	Department of Plant Sciences	James Hammond	Faculty	Flax
North Dakota State University	Department of Plant Sciences	G. Francois Marais	Faculty	Hard red spring wheat
North Dakota State University	Department of Plant Sciences	Mohamed Mergoum	Faculty	Hard red spring wheat, hard white, specialty spring wheat
North Dakota State University	Department of Plant Sciences	Paul Schwarz	Faculty	Malting Barley
North Dakota State University	Department of Plant Sciences	Michael McMullen	Faculty	Oat
North Dakota State University	Department of Plant Sciences	Asunta (Susie) Thompson	Faculty	Potato
North Dakota State University	Department of Plant Sciences	Kevin McPhee	Faculty	Pulse crop
North Dakota State University	Department of Plant Sciences	Theodore Helms	Faculty	Soybean
North Dakota State University	Department of Plant Sciences	Chiwon Lee	Faculty	Vegetables
North Dakota State University	Department of Plant Sciences	Xiwen Cai	Faculty	Wheat
North Dakota State University	Department of Plant Sciences	Shahryar	Faculty	Wheat
North Dakota State University	Department of Plant Sciences	M. Javed Iqbal	Faculty	Wheat
North Dakota State University	Department of Plant Sciences	Farhad Ghavami	Faculty	Wheat
North Dakota State University	Department of Plant Sciences	Todd West	Faculty	Woody plant
Northwest Missouri State University	School of Agricultural Sciences	Thomas Zweifel	Faculty	Unclear
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Eric Stockinger	Faculty	Barley, wheat, rye
Ohio State University	College of Food, Agricultural, and Environmental Sciences	David Mackey	Faculty	Maize
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Pablo Jourdan	Faculty	Ornamental trees and shrubs
Ohio State University	College of Food, Agricultural, and Environmental Sciences	John Finer	Faculty	Soybean

Institution	Department	Name	Position	Crop
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Leah Mchale	Faculty	Soybean
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Esther Van Der Knaap	Faculty	Tomato
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Katrina Cornish	Faculty	Unclear
Ohio State University	College of Food, Agricultural, and Environmental Sciences	David Francis	Faculty	Unclear
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Erich Grotewold	Faculty	Unclear
Ohio State University	College of Food, Agricultural, and Environmental Sciences	JC Chang	Faculty	Unclear
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Michelle Jones	Faculty	Unclear
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Clay Sneller	Faculty	Wheat
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Laura Lindsey	Faculty	Wheat
Ohio State University	College of Food, Agricultural, and Environmental Sciences	Pierce Paul	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Yanqi Wu	Faculty	Grasses
Oklahoma State University	Department of Plant and Soil Sciences	Bruce Dunn	Faculty	Ornamentals
Oklahoma State University	Department of Plant and Soil Sciences	Brett Carver	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Liuling Yan	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Jeff Edwards	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Robert Hunger	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Art Klatt	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Tom Royer	Faculty	Wheat

Institution	Department	Name	Position	Crop
Oklahoma State University	Department of Plant and Soil Sciences	Kris Giles	Faculty	Wheat
Oklahoma State University	Department of Plant and Soil Sciences	Patricia Ryas-Duarte	Faculty	Wheat
Oregon State University	College of Agricultural Sciences	Barbara Reed	Faculty	Apricot, berries
Oregon State University	College of Agricultural Sciences	Patrick Hayes	Faculty	Barley
Oregon State University	College of Agricultural Sciences	Alfonso Cuesta-Marcos	Faculty	Barley
Oregon State University	College of Agricultural Sciences	Keith Jayawickrama	Faculty	Conifers
Oregon State University	College of Agricultural Sciences	Laurent Deluc	Faculty	Grape
Oregon State University	College of Agricultural Sciences	Shawn Mehlenbacher	Faculty	Hazelnut
Oregon State University	College of Agricultural Sciences/USDA-ARS	John Henning	USDA-ARS Research Plant Geneticist (PhD)	Hops
Oregon State University	College of Agricultural Sciences	Shaun Townsend	Faculty	Hops
Oregon State University	College of Agricultural Sciences	Jennifer Kling	Faculty	Oat
Oregon State University	College of Agricultural Sciences	Clinton Shock	Faculty	Onion, potato
Oregon State University	College of Agricultural Sciences	Ryan Contereas	Faculty	Ornamentals
Oregon State University	College of Agricultural Sciences	Brian Charlton	Faculty	Potato
Oregon State University	College of Agricultural Sciences	Vidyasagar (Sagar) Sathuvalli	Faculty	Potato
Oregon State University	College of Agricultural Sciences	Solomon Yilma	Faculty	Potato
Oregon State University	College of Agricultural Sciences/USDA-ARS	Chad Finn	USDA-ARS Research Geneticist and Small Fruit Breeder (PhD)	Small fruit breeding

Institution	Department	Name	Position	Crop
Oregon State University	College of Agricultural Sciences	Jim Myers	Faculty	Vegetables
Oregon State University	College of Agricultural Sciences	Jeff Leonard	Faculty	Wheat
Oregon State University	College of Agricultural Sciences	Michael Flowers	Faculty	Wheat
Oregon State University	College of Agricultural Sciences	Andrew Ross	Faculty	Wheat
Oregon State University	College of Agricultural Sciences	Robert Zemetra	Faculty	Wheat
Pennsylvania State University	Department of Plant Science	Robert Crassweller	Faculty	Apple, grape
Pennsylvania State University	Department of Plant Science	Timothy McNellis	Faculty	Apple, tomatoes
Pennsylvania State University	Department of Plant Science	Kathy Demchak	Faculty	Berries
Pennsylvania State University	Department of Plant Science	John E. Carlson	Faculty	Chesnut genetics
Pennsylvania State University	Department of Plant Science	Marvin Hall	Faculty	Forage
Pennsylvania State University	Department of Plant Science	James Schupp	Faculty	Fruit trees
Pennsylvania State University	Department of Plant Science	Gregory Roth	Faculty	Grains, soybeans, corn, sorghum, forage crops, winter wheat
Pennsylvania State University	Department of Plant Science	Cristina Rosa	Faculty	Grape
Pennsylvania State University	Department of Plant Science	Michela Centinari	Faculty	Grape
Pennsylvania State University	Department of Plant Science	Surinder Chopra	Faculty	Maize and sorghum genetics
Pennsylvania State University	Department of Plant Science	Kathleen M. Brown	Faculty	Maize, common bean, rice
Pennsylvania State University	Department of Plant Science	David Meigs Beyer	Faculty	Mushrooms
Pennsylvania State University	Department of Plant Science	John Pecchia	Faculty	Mushrooms
Pennsylvania State University	Department of Plant Science	Daniel J. Royse	Faculty	Mushrooms
Pennsylvania State University	Department of Plant Science	Barbara Christ	Faculty	Potato
Pennsylvania State University	Department of Plant Science	Xinshun Qu	Faculty	Potato

Institution	Department	Name	Position	Crop
Pennsylvania State University	Department of Plant Science	William Lamont, Jr.	Faculty	Potato
Pennsylvania State University	Department of Plant Science	Yinong Yang	Faculty	Rice, potato, mushroom
Pennsylvania State University	Department of Plant Science	Mark Guiltinan	Faculty	*Theobroma cacao* (cocoa)
Pennsylvania State University	Department of Plant Science	Majid R. Foolad	Faculty	Tomato
Pennsylvania State University	Department of Plant Science	David R. Huff	Faculty	Turfgrass
Pennsylvania State University	Department of Plant Science	James Sellmer	Faculty	Unclear
Pennsylvania State University	Department of Plant Science	Siela Nikolova Maximova	Faculty	Unclear
Pennsylvania State University	Department of Plant Science	Rick Bates	Faculty	Woody plants, Christmas trees
Prairie View A&M University	College of Agriculture and Human Sciences, Cooperative Agricultural Research Center	Godson O. Osuji	Faculty	Maize and leguminous and root/tuber crops
Prairie View A&M University	—	Aruna Weerasooriya	Faculty	Medicinal plants
Prairie View A&M University	—	Ming Gao	Faculty	Sweet potato
Purdue University	Agronomy	Joe Anderson	Faculty	Wheat
Purdue University	Horticulture and Landscape Architecture	Peter Hirst	Faculty	Apple
Purdue University	Horticulture and Landscape Architecture	Jules Janick	Faculty	Arugula, winecrisp apple
Purdue University	Horticulture and Landscape Architecture	Bruce P Bordelon	Faculty	Grape and small fruits
Purdue University	Agronomy	Torbert Rocheford	Faculty	Maize
Purdue University	Agronomy	Mitch Tuinstra	Faculty	Maize
Purdue University	Agronomy	Tony Vyn	Faculty	Maize
Purdue University	Agronomy	Cliff Weil	Faculty	Maize
Purdue University	Botany and Plant Pathology	Guri Johal	Faculty	Maize
Purdue University	Agronomy	Mohsen Mohammadi	Faculty	Soft red winter wheat

Institution	Department	Name	Position	Crop
Purdue University	Agronomy	Gebisa Ejeta	Faculty	Sorghum
Purdue University	Horticulture and Landscape Architecture	Brian Dilkes	Faculty	Sorghum, mint, and maize
Purdue University	Agronomy	Shaun Casteel	Faculty	Soybean
Purdue University	Agronomy	Karen Hudson	Adjunct Assistant Professor USDA	Soybean
Purdue University	Agronomy	Jianxin Ma	Faculty	Soybean
Purdue University	Agronomy	Katy Martin Rainey	Faculty	Soybean
Purdue University	Forestry and Natural Resources	Keith Woeste	Adjunct Assist. Professor of Forestry	Tree breeding
Purdue University	Agronomy	Christie Williams	Adjunct Associate Professor	Wheat
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Chee-Kok Chin	Faculty	Asparagus
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Nicholi Vorsa	Faculty	Cranberry
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Elwin Orton	Faculty	Dogwood, holly
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Thomas Molnar	Faculty	Hazelnut, dogwood, other woody ornamentals
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	James E. Simon	Faculty	New crop development, non-timber forest species
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Joseph Goffreda	Faculty	Peach, nectarine, apple, and apricot
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Thomas J. Orton	Faculty	Tomato, and asparagus
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Josh A. Honig	Faculty	Turfgrass

Institution	Department	Name	Position	Crop
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	William Meyer	Faculty	Turfgrass
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Stacy Bonos	Faculty	Turfgrass and switchgrass
Rutgers, The State University of New Jersey	Department of Plant Biology and Pathology	Dan Ward	Faculty	Wine grape
South Dakota State University	—	Anne Fennell	Faculty	Grape
South Dakota State University	College of Agriculture & Biological Sciences, Department of Plant Science	Melanie Caffe	Faculty	Oat
South Dakota State University	—	Kathleen Grady	Faculty	Oilseeds, sunflower
South Dakota State University	—	Karl Glover	Faculty	Spring Wheat
South Dakota State University	—	Sunish Sehgal	Faculty	Winter wheat
Southern Illinois University	College of Agricultural Sciences	Alan Walters	Faculty	Horseradish, pumpkin
Southern Illinois University	College of Agricultural Sciences	Ken Diesburg	Faculty	Perennial grasses: turfgrass, zoysia grass
Southern Illinois University	College of Agricultural Sciences	Khalid Meksem	Faculty	Potato, soybean
Southern Illinois University	College of Agricultural Sciences	Stella Kantartzi	Faculty	Soybean
Southern Illinois University	College of Agricultural Sciences	Jason Bond	Faculty	Soybean
Southern Illinois University	College of Agricultural Sciences	Andrew Wood	Faculty	Soybean
Southern Illinois University	College of Agricultural Sciences	David A. Lightfoot	Faculty	Soybean
Stephen F. Austin State University	Arthur Temple College of Forestry and Agriculture	Dave Creech	Faculty	Blueberry
Tennessee State University	Department of Agricultural & Environmental Sciences	Matthew Blair	Faculty	Beans
Tennessee State University	Department of Agricultural & Environmental Sciences	Jason P. de Koff	Faculty	Biofuel crops

Institution	Department	Name	Position	Crop
Tennessee State University	Department of Agricultural & Environmental Sciences	Nick Gawel	Faculty	Hydrangea, Clethra, Styrax, and Cornus (dogwood)
Tennessee State University	Department of Agricultural & Environmental Sciences	Dilip Nandwani	Faculty	Mango, cucumber, tomato, okra, sweet pepper, hot pepper, banana, pineapple, curry
Tennessee State University	Department of Agricultural & Environmental Sciences	Arvazena E. Clardy	Faculty	Ornamental grasses
Tennessee State University	Department of Agricultural & Environmental Sciences	Anthony Witcher	Faculty	Pine, ornamental ginger
Tennessee State University	Department of Agricultural & Environmental Sciences	Dharma Pitchay	Faculty	Plant nutrition, sustainable organic farming, greenhouse/plasticulture production and tropical horticulture
Tennessee State University	Department of Agricultural & Environmental Sciences	Ali Taheri	Faculty	Soybean, canola, camelina
Tennessee State University	Department of Agricultural & Environmental Sciences	Suping Zhou	Faculty	Tomato, asparagus
Tennessee State University	Department of Agricultural & Environmental Sciences	Lisa Alexander	Faculty	Unclear
Tennessee State University	Department of Agricultural & Environmental Sciences	Fitzroy (Roy) Bullock	Faculty	Vegetables, fruits, soybean, nurseries, turf and ornamentals, roadsides, non-crop lands, pastures, limited work on corn and cotton
Tennessee State University	Department of Agricultural & Environmental Sciences/USDA-ARS	Donna Fare	Research Horti-culturist, USDA/ARS (PhD)	Woody ornamentals
Texas A&M University	Department of Soil and Crop Sciences	Seth Murray	Faculty	Corn

Institution	Department	Name	Position	Crop
Texas A&M University	Department of Soil and Crop Sciences	Wenwei Xu	Joint Appoint-ment with the Texas AgriLife Research and Texas Tech Depart-ment of Plant and Soil Science	Corn
Texas A&M University	Department of Soil and Crop Sciences	Jane Dever	Adjunct Professor at Texas Tech	Cotton
Texas A&M University	Department of Soil and Crop Sciences	Wayne Smith	Faculty	Cotton
Texas A&M University	Department of Soil and Crop Sciences	David Stelly	Faculty	Cotton
Texas A&M University	Lubbock Research and Extension Center	Jane Dever	Faculty	Cotton
Texas A&M University	Department of Soil and Crop Sciences	Steve Hague	Faculty	Cotton, oilseeds
Texas A&M University	Department of Soil and Crop Sciences	B.B. Singh	Visiting Faculty	Cowpea
Texas A&M University	Stephenville Research and Extension Center	James (Jim) Pierre Muir	Faculty	Forage peanut, legume
Texas A&M University	Department of Soil and Crop Sciences	Gary Peterson	Adjunct Professor Texas Tech University	Grain sorghum
Texas A&M University	Department of Horticulture	Larry Stein	Faculty	Grape, bluebonnets, pecans, fruit and vegetable crops
Texas A&M University	Department of Soil and Crop Sciences	Ray Smith	Faculty	Legumes
Texas A&M University	Department of Horticultural Sciences	Kevin Crosby	Faculty	Melon, pepper, tomato, onion, carrot
Texas A&M University	Department of Soil and Crop Sciences	Michael Baring	Faculty	Peanut
Texas A&M University	Department of Soil and Crop Sciences	Russell Jessup	Faculty	Perennial grasses

Institution	Department	Name	Position	Crop
Texas A&M University	Department of Horticultural Sciences	J. Creighton Miller, Jr.	Faculty	Potato
Texas A&M University	Department of Soil and Crop Sciences	Rodante Tabien	Faculty	Rice
Texas A&M University	Department of Horticultural Sciences	David Byrne	Faculty	Rose, stone fruit, nectarine
Texas A&M University	Department of Soil and Crop Sciences	Calvin Trostle	TAMU Professor & Extension Agrono-mist. TTU Adjunct Associate Professor	Row crops, peanuts, alfalfa
Texas A&M University	Department of Soil and Crop Sciences	Amir Ibrahim	Faculty	Small grains
Texas A&M University	Department of Soil and Crop Sciences	Bill Rooney	Faculty	Sorghum, bioenergy
Texas A&M University	Department of Soil and Crop Sciences	Jorge DaSilva	Faculty	Sugarcane and bioenergy cane
Texas A&M University	Department of Soil and Crop Sciences	Ambika Chandra	Faculty	Turfgrass
Texas A&M University	Department of Soil and Crop Sciences	Dirk Hays	Faculty	Wheat
Texas A&M University	Department of Soil and Crop Sciences	Shuyu Liu	Faculty	Wheat
Texas A&M University	Department of Soil and Crop Sciences	Jackie Rudd	Faculty	Wheat
Texas A&M University	Department of Soil and Crop Sciences	David Drake	Assistant Professor and Extension Agrono-mist	Wheat, oilseed crops
Texas A&M University & Texas Tech University	Department of Soil and Crop Sciences	Mark Burow	Joint Appoint-ment with Texas AgriLife Research and Texas Tech Depart-ment of Plant and Soil Science	Peanut

Institution	Department	Name	Position	Crop
Texas Tech University	Department of Plant and Soil Science	Dick Auld	Faculty	Canola, cotton, minor oilseed crops
Texas Tech University	Department of Plant and Soil Science	Robert Wright	Faculty	Cotton
Texas Tech University	Department of Plant and Soil Science	Roy Cantrell	Adjunct Professor/ Monsanto Company	Cotton
Texas Tech University	Department of Plant and Soil Science	Richard Sheetz	Adjunct Professor/ Monsanto Company	Cotton
Texas Tech University	Department of Plant and Soil Science	Glen Ritchie	Faculty	Cotton, sorghum
Texas Tech University	Department of Plant and Soil Science	Joe Bouton	Adjunct Professor and Director, Forage Improvement Div. Samuel Roberts Nobel Foundation; Emeritus Professor at UGA	Forage, bioenergy cultivars
Texas Tech University	Department of Plant and Soil Science	Ed Hellman	Joint Appoint-ment with Texas AgriLife Extension and Texas Tech Depart-ment of Plant and Soil Science	Grape
Texas Tech University	Department of Plant and Soil Science	Bruce Maunder	Adjunct Professor/ DeKalb Plant Genetics	Sorghum

Institution	Department	Name	Position	Crop
Texas Tech University	Department of Horticultural Sciences	Russell Wallace	Adjunct Assistant Professor	Vegetable
Texas Tech University	Department of Plant and Soil Science	Thayne Montague	Faculty	Woody ornamental plants (oak), grapevines, olives
Truman State	Agricultural Science	Mark Campbell	Faculty	Maize
Tufts University	Biology	George S Ellmore	Faculty	Garlic
Tuskegee University	College of Agriculture Environment and Nutrition Sciences	Conrad Bonsi	Faculty	Sweet potato
Tuskegee University	College of Agriculture Environment and Nutrition Sciences	Marceline Egnin	Faculty	Sweet potato
Tuskegee University	College of Agriculture Environment and Nutrition Sciences	Guohao He	Faculty	Sweet potato
United Tribes Technical College	Tribal Environmental Science	Jen Janecek-Hartman	Faculty	Maize
University of Alaska	Natural Resources, School of and Extension	Mingchu Zhang	Faculty	Cereals
University of Alaska	Natural Resources, School of and Extension	Patricia Holloway	Faculty	Peonies, wild berries, lingonberry, fern
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	Glenn C. Wright	Extension Horti-culturist, The School of Plant Sciences	Citrus, date palms, olives, pomegranates
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	E. Davison	Faculty	*Cordia boissieri* and *Cordia parvifolia*
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	Jeffrey C. Silvertooth	Faculty	Cotton, cantaloupes

Institution	Department	Name	Position	Crop
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	Ursula Schuch	Extension Specialist and Professor, The School of Plant Sciences	Rose, trees, shrubs
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	Michael Ottman	Faculty	Sorghum, alfalfa, wheat
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	Monica Schmidt	Faculty	Soybean, oilseeds
University of Arizona	College of Agriculture and Life Sciences, School of Plant Sciences	Chieri Kubota	Faculty	Vegetables, strawberries
University of Arkansas	Department of Crop, Soil, and Environmental Sciences	Fred M. Bourland	Faculty	Cotton
University of Arkansas	Department of Crop, Soil, and Environmental Sciences	Karen A. Moldenhauer	Faculty	Rice
University of Arkansas	Department of Crop, Soil, and Environmental Sciences	Xueyan Sha	Faculty	Rice
University of Arkansas	Department of Crop, Soil, and Environmental Sciences	Pengyin Chen	Faculty	Soybean
University of Arkansas	Department of Crop, Soil, and Environmental Sciences	Esten Mason	Faculty	Wheat
University of Arkansas	Department of Crop, Soil, and Environmental Sciences	Robert K. Bacon	Faculty	Winter wheat, oats, canola
University of Arkansas at Pine Bluff	—	Definitely has a plant/ agriculture program, but no faculty listed	Faculty	Unclear
University of California, Davis	Department of Plant Sciences	Dan Kliebenstein	Faculty	Arabidopsis thaliana, tomato, grape
University of California, Davis	Department of Plant Sciences	Paul Gepts	Faculty	Bean, chickpea

Institution	Department	Name	Position	Crop
University of California, Davis	Department of Plant Sciences	Doug Cook	Faculty	Chickpea
University of California, Davis	Department of Plant Sciences	Mikeal Roose	Faculty	Citrus, Asparagus
University of California, Davis	Department of Plant Sciences	Carol J. Lovatt	Faculty	Citrus, avocado, other subtropical tree crops, pistachio
University of California, Davis	Department of Plant Sciences	Timothy Close	Faculty	Cowpea, barley, citrus
University of California, Davis	Department of Plant Sciences	Ted DeJong	Faculty	Dried plum/prune
University of California, Davis	Department of Plant Sciences	David Neale	Faculty	Forest trees
University of California, Davis	Department of Plant Sciences	Andy Walker	Faculty	Grape
University of California, Davis	Department of Plant Sciences	Richard Michelmore	Faculty	Lettuce
University of California, Davis	Department of Plant Sciences	Kent Bradford	Faculty	Lettuce
University of California, Davis	Department of Plant Sciences	Lynn Epstein	Faculty	Lettuce
University of California, Davis	Department of Plant Sciences	Jeffrey Ross-Ibarra	Faculty	Maize
University of California, Davis	Department of Plant Sciences	J. Giles Waines	Faculty	Ornamental lilacs and salvias
University of California, Davis	Department of Plant Sciences	Allen Van Deynze	Faculty	Pepper
University of California, Davis	Department of Plant Sciences	Dan Parfitt	Faculty	Pistachio
University of California, Davis	Department of Plant Sciences	Thomas Gradziel	Faculty	Prunus species (genus of trees and shrubs, which includes the plums, cherries, peaches, nectarines, apricots and almonds)
University of California, Davis	Department of Plant Sciences	Gurdev Khush	Adjunct Professor	Rice
University of California, Davis	Department of Plant Sciences	Pamela Ronald	Faculty	Rice
University of California, Davis	Department of Plant Sciences	Eduardo Blumwald	Faculty	Rice, millet, wheat, cereals
University of California, Davis	Department of Plant Sciences	Steven Knapp	Faculty	Strawberry

Institution	Department	Name	Position	Crop
University of California, Davis	Department of Plant Sciences	Ann Powell	Faculty	Tomato
University of California, Davis	Department of Plant Sciences	Alan Bennett	Faculty	Tomato
University of California, Davis	Department of Plant Sciences	Roger Chetelat	Faculty	Tomato
University of California, Davis	Department of Plant Sciences	Jim Baird	Faculty	Turfgrass
University of California, Davis	Department of Plant Sciences	Dina St. Clair	Faculty	Unclear
University of California, Davis	Department of Plant Sciences	Shizhong Xu	Faculty	Unclear
University of California, Davis	Department of Plant Sciences	Jorge Dubcovsky	Faculty	Wheat
University of California, Davis	Department of Plant Sciences	Charlie Brummer	Faculty	Wild rice, alfalfa, other forage crops
University of Connecticut	College of Agriculture, Health and Natural Resources, Plant Science and Landscape Architecture	Jessica Lubell	Faculty	Native shrubs
University of Connecticut	College of Agriculture, Health and Natural Resources, Plant Science and Landscape Architecture	Mark H. Brand	Faculty	Ornamental plant breeding (11 rhododendron cultivars), Switchgrass, Native shrubs, Ornamental shrubs: *Berberis thunbergii* (Japanese barberry), *Euonymus alata* (burning bush), Buddleja
University of Connecticut	College of Agriculture, Health and Natural Resources, Plant Science and Landscape Architecture	Yi Li	Faculty	Sterile ornamental cultivars: Berberis thunbergii (Japanese barberry), Euonymus alata (burning bush)
University of Connecticut	College of Agriculture, Health and Natural Resources, Plant Science and Landscape Architecture	Richard J. McAvoy	Faculty	Unclear

Institution	Department	Name	Position	Crop
University of Delaware	Department of Plant and Soil Sciences	Tom Evans	Faculty	Lima bean
University of Delaware	Department of Plant and Soil Sciences	Gordon C. Johnson	Faculty	Unclear
University of Florida	Institute of Food and Agricultural Sciences	Jianping Wang	Faculty	Biofuel (sugarcane and elephant grass), row crops (peanut)
University of Florida	Horticultural Sciences Department	James Olmstead	Faculty	Blueberry
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	Zhanao Deng	Faculty	Caladium, gerbera, lantana
University of Florida	Citrus Research and Education Center	Fred Gmitter	Faculty	Citrus
University of Florida	Citrus Research and Education Center	Jude Grosser	Faculty	Citrus
University of Florida	Horticultural Sciences Department	Gloria Moore	Faculty	Citrus
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	Thomas Colquhuon	Faculty	Dicot/monocot, petunia/lilium; tomato, strawberry, blueberry, peach, basil
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	David Clark	Faculty	Flowers
University of Florida	Institute of Food and Agricultural Sciences	Ann Blount	Faculty	Forage
University of Florida	Everglades Research and Education Center	Huangjun Lu	Faculty	Lettuce
University of Florida	Horticultural Sciences Department	Donald R. McCarty	Faculty	Maize
University of Florida	Horticultural Sciences Department	A. Mark Settles	Faculty	Maize
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	Wagner Vendrame	Faculty	Orchids, apple
University of Florida	Institute of Food and Agricultural Sciences	Barry L. Tillman	Faculty	Peanut

Institution	Department	Name	Position	Crop
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	Rosanna Freyre	Faculty	Ruellia
University of Florida	Institute of Food and Agricultural Sciences, Horticulture Sciences Department	Jose X. Chaparro	Faculty	Stone fruit and citrus
University of Florida	Institute of Food and Agricultural Sciences	Vance Whitaker	Faculty	Strawberry
University of Florida	Institute of Food and Agricultural Sciences	Robert Gilbert	Faculty	Sugarcane
University of Florida	Institute of Food and Agricultural Sciences	Sam Hutton	Faculty	Tomato
University of Florida	Institute of Food and Agricultural Sciences	John "Jay" Scott	Faculty	Tomato
University of Florida	Institute of Food and Agricultural Sciences	Fredy Altpeter	Faculty	Turf, biomass/ bioenergy grasses
University of Florida	Institute of Food and Agricultural Sciences	Kevin E. Kenworthy	Faculty	Turfgrass
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	Jianjun Chen	Faculty	Unclear
University of Florida	Institute of Food and Agricultural Sciences, Environmental Horticulture	Charles Guy	Faculty	Unclear
University of Georgia	Department of Crop and Soil Sciences	Lloyd May	Faculty	Cotton
University of Georgia	Department of Crop and Soil Sciences	Ali Missaoui	Faculty	Forages
University of Georgia	Department of Crop and Soil Sciences	Scott Jackson	Faculty	Legumes, rice
University of Georgia	Department of Crop and Soil Sciences	Wayne Hanna	Faculty	New grasses used for forage and turf
University of Georgia	Department of Crop and Soil Sciences	Bill Branch	Faculty	Peanut
University of Georgia	Department of Horticulture	Patrick Conner	Faculty	Pecan
University of Georgia	Department of Crop and Soil Sciences	Zenglu Li	Faculty	Soybean
University of Georgia	Department of Crop and Soil Sciences	Roger Boerma	Faculty	Soybean
University of Georgia	Department of Crop and Soil Sciences	Wayne Parrott	Faculty	Soybean, alfalfa, and peanut

Institution	Department	Name	Position	Crop
University of Georgia	Department of Crop and Soil Sciences	Paul L. Raymer	Faculty	Turfgrass, canola
University of Georgia	Department of Crop and Soil Sciences	Brian Schwartz	Faculty	Turfgrass, including Bermudagrass, centipedegrass, and zoysiagrass
University of Georgia	Department of Crop and Soil Sciences	Katrien Devos	Faculty	Wheat, pearl millet, finger millet
University of Georgia	Department of Crop and Soil Sciences	Jerry Johnson	Faculty	Wheat, rye, barley
University of Guam	College of Natural and Applied Sciences	Mari Marutani	Faculty	Local corn, pepper, pumpkin
University of Guam	College of Natural and Applied Sciences	Andrea Blas	Faculty	Papaya
University of Hawaii	Department of Tropical Plant & Soil Sciences	James L. Brewbaker	Faculty	Corn, koa, forage crops
University of Hawaii	Department of Tropical Plant & Soil Sciences	Teresita Amore	Faculty	Orchids, anthurium
University of Hawaii	Department of Tropical Plant & Soil Sciences	Richard M. Manshardt	Faculty	Tropical fruit
University of Idaho	Department of Plant, Soil and Entomological Sciences	Shree Singh	Faculty	Dry bean
University of Idaho	Department of Plant, Soil and Entomological Sciences	Jianli Chen	Faculty	Grains, wheat
University of Idaho	Department of Plant, Soil and Entomological Sciences	Mike Thornton	Faculty	Potato, onion
University of Idaho	Department of Plant, Soil and Entomological Sciences	Jack Brown	Faculty	Rapeseed, canola
University of Idaho	Department of Plant, Soil and Entomological Sciences	Stephen Love	Faculty	Unclear
University of Illinois	Department of Crop Sciences	Martin Bohn	Faculty	Corn
University of Illinois	Department of Crop Sciences	G. R. Johnson	Adjunct	Corn
University of Illinois	Department of Crop Sciences	Forrest Troyer	Adjunct	Corn
University of Illinois	Department of Crop Sciences	Rita Mumm	Faculty	Maize

Institution	Department	Name	Position	Crop
University of Illinois	Department of Crop Sciences	Stephen Long	Faculty	Maize, soy, sorghum, sugarcane, cassava, Miscanthus
University of Illinois	Department of Crop Sciences	Erik Sacks	Faculty	Perennial grasses
University of Illinois	Department of Crop Sciences	Patrick Brown	Faculty	Sorghum
University of Illinois	Department of Crop Sciences	Brian Diers	Faculty	Soybean
University of Illinois	Department of Crop Sciences	Glen Hartman	Faculty	Soybean
University of Illinois	Department of Crop Sciences	Randall Nelson	Faculty	Soybean
University of Illinois	Department of Crop Sciences	David R. Walker	Faculty	Soybean
University of Illinois	Department of Crop Sciences	Schuyler Korban	Faculty	Unclear
University of Illinois	Department of Crop Sciences	John Juvik	Faculty	Vegetable
University of Illinois	Department of Crop Sciences	Frederic L. Kolb	Faculty	Wheat, oats
University of Kentucky	Department of Crop and Soil Sciences	Robert Miller	Faculty	Burley, dark tobacco
University of Kentucky	Department of Horticulture	Kirk W. Pomper	Faculty	Papaya
University of Kentucky	Department of Horticulture	Brent Rowell	Faculty	Pepper
University of Kentucky	Department of Crop and Soil Sciences	David Van Sanford	Faculty	Soft wheat
University of Kentucky	Department of Crop and Soil Sciences	Todd Pfeiffer	Faculty	Sorghum
University of Kentucky	Department of Crop and Soil Sciences	David Hildebrand	Faculty	Soybean
University of Kentucky	Department of Crop and Soil Sciences	Hongyan Zhu	Faculty	Soybean, alfalfa, legumes
University of Kentucky	Department of Crop and Soil Sciences	Tim Phillips	Faculty	Tall fescue, rose
University of Kentucky	Department of Crop and Soil Sciences	Randy Dinkins	Faculty	Unclear
University of Kentucky	Department of Crop and Soil Sciences	H. Davies	Faculty	Unclear

Institution	Department	Name	Position	Crop
University of Maine	College of Natural Sciences, Forestry, and Agriculture, Plant, Soil and Environmental Sciences	Greg Porter	Faculty	Potato
University of Maryland (at College Park)	Department of Plant Science and Landscape Architecture	Christopher Walsh	Faculty	Apple, fruits
University of Maryland (at College Park)	Department of Plant Science and Landscape Architecture	Shunyuan Xiao	Faculty	Arabidopsis thaliana
University of Massachusetts, Amherst	School of Agriculture	Scott Ebdon	Faculty	Bluegrass, ryegrass
University of Massachusetts, Amherst	School of Agriculture	Om Parkash (Dhankher)	Faculty	Unclear
University of Massachusetts, Amherst	School of Agriculture	Geunhwa Jung	Faculty	Turfgrass
University of Minnesota	Department of Horticultural Science	Jim Luby	Faculty	Apple, grape
University of Minnesota	Department of Plant Biology	Gary Muehlbauer	Faculty	Barley
University of Minnesota	Department of Agronomy and Plant Genetics	Kevin P. Smith	Faculty	Barley
University of Minnesota	Department of Agronomy and Plant Genetics	Gary J Muehlbauer	Faculty	Barley
University of Minnesota	Department of Horticultural Science	Tom Michaels	Faculty	Beans, salad greens
University of Minnesota	Department of Agronomy and Plant Genetics	Rex Bernardo	Faculty	Corn
University of Minnesota	Department of Horticultural Science	Neil O. Anderson	Faculty	Flowers
University of Minnesota	Department of Horticultural Science	Matthew Clark	Faculty	Grape
University of Minnesota	Department of Horticultural Science	Cindy Tong	Faculty	Honeycrisp apple
University of Minnesota	Department of Horticultural Science	Vince Fritz	Faculty	Hops
University of Minnesota	Department of Plant Biology	David Marks	Faculty	Pennycress

Institution	Department	Name	Position	Crop
University of Minnesota	Department of Plant Biology	Clay Carter	Faculty	Pennycress
University of Minnesota	Department of Horticultural Science	Stan C. Hokanson	Faculty	Rose
University of Minnesota	Department of Agronomy and Plant Genetics	Robert M. Stupar	Faculty	Soybean
University of Minnesota	Department of Agronomy and Plant Genetics	James H. Orf	Faculty	Soybean
University of Minnesota	Department of Horticultural Science	Changbin Chen	Faculty	Tomato
University of Minnesota	Department of Horticultural Science	Eric Watkins	Faculty	Turfgrass
University of Minnesota	Department of Agronomy and Plant Genetics	James A Anderson	Faculty	Wheat
University of Minnesota	Department of Horticultural Science	Alan G. Smith	Faculty	Woody landscape
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	J. Perry Gustafson	Adjunct	Cereals
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Chin-Feng Hwang	Adjunct	Grape
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Anne McKendry	Faculty	Red winter wheat
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Hari Krishnan	Adjunct	Soybean
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Jason Gillman	Adjunct	Soybean
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Paul Beuselinck	Adjunct	Soybean
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Kristen Bilyeu	Adjunct	Soybean

Institution	Department	Name	Position	Crop
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Prakash Arelli	Adjunct	Soybean
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Gary Stacey	Faculty	Soybean
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	J. Grover Shannon	Faculty	Soybean
University of Missouri	College of Agriculture, Food and Natural Resources, Division of Plant Sciences	Henry Nguyen	Faculty	Soybean
University of Nebraska	Department of Agronomy and Horticulture	Andrew Hopkins	Adjunct	Corn
University of Nebraska	Department of Agronomy and Horticulture	Blaine Johnson	Adjunct	Corn
University of Nebraska	Department of Agronomy and Horticulture	Carlos Urrea	Faculty	Dry bean
University of Nebraska	Department of Agronomy and Horticulture	Paul E. Read	Faculty	Grape (juice & wine)
University of Nebraska	Department of Agronomy and Horticulture	Dipak Santra	Faculty	Millet
University of Nebraska	Department of Agronomy and Horticulture	Oscar Rodriguez	Faculty	Popcorn
University of Nebraska	Department of Agronomy and Horticulture	David Holding	Faculty	Popcorn
University of Nebraska	Department of Agronomy and Horticulture	Jeffrey F. Pedersen	Faculty	Sorghum
University of Nebraska	Department of Agronomy and Horticulture	George L. Graef	Faculty	Soybean
University of Nebraska	Department of Agronomy and Horticulture	David L. Hyten	Faculty	Soybean

Institution	Department	Name	Position	Crop
University of Nebraska	Department of Agronomy and Horticulture	Thomas Clemente	Faculty	Soybean, wheat, maize, sorghum
University of Nebraska	Department of Agronomy and Horticulture	Stacy Adams	Faculty	Strawberry
University of Nebraska	Department of Agronomy and Horticulture	Mark Lagrimini	Faculty	Tobacco
University of Nebraska	Department of Agronomy and Horticulture	Hugo Ferney Gomez Bacerra	Adjunct	Wheat
University of Nebraska	Department of Agronomy and Horticulture	Edward J. Souza	Adjunct	Wheat
University of Nebraska	Department of Agronomy and Horticulture	P. Stephen Baenziger	Faculty	Wheat
University of Nebraska	Department of Agronomy and Horticulture	Brian M. Waters	Faculty	Wheat, melon
University of Nebraska	Department of Agronomy and Horticulture	Roger W. Elmore	Faculty	Wheat, soybean
University of Nebraska	Department of Agronomy and Horticulture	William Berzonsky	Adjunct	Winter wheat
University of Nebraska	Department of Agronomy and Horticulture	Janet Lewis	Adjunct	Winter wheat
University of New Hampshire	Department of Biological Sciences	Iago Hale	Faculty	Kiwi
University of New Hampshire	Department of Biological Sciences	Becky Sideman	Faculty	Lettuce
University of Tennessee (Knoxville)	College of Agricultural Sciences and Natural Resources, Department of Plant Sciences	Vince Pantalone	Faculty	Soybean
University of Tennessee (Knoxville)	College of Agricultural Sciences and Natural Resources, Department of Plant Sciences	Fred Allen	Faculty	Soybean
University of Tennessee (Knoxville)	College of Agricultural Sciences and Natural Resources, Department of Plant Sciences	Bob Miller	Faculty	Tobacco

Institution	Department	Name	Position	Crop
University of Tennessee (Knoxville)	College of Agricultural Sciences and Natural Resources, Department of Plant Sciences	Dennis West	Faculty	Wheat, corn
University of Tennessee (Martin)	Agriculture	Wesley Totten	Faculty	Tobacco
University of Tennessee (Martin)	Agriculture	Barbara A Darroch	Faculty	Tobacco, wheat, rye
University of Vermont	Plant Biology	Terrence P Delaney	Faculty	Arabidopsis thaliana
University of Wisconsin, Madison	Department of Horticulture	Philipp Simon	Faculty	Carrot, garlic
University of Wisconsin, Madison	Department of Horticulture	Irwin Goldman	Faculty	Carrot, onion, beet
University of Wisconsin, Madison	Department of Agronomy	Natalia de Leon	Faculty	Corn
University of Wisconsin, Madison	Department of Horticulture	Yiqun Weng	Faculty	Cucumber
University of Wisconsin, Madison	Department of Horticulture	Michael Havey	Faculty	Onion, cucumber
University of Wisconsin, Madison	Department of Horticulture	Jeffrey Endelman	Faculty	Potato
University of Wisconsin, Madison	Department of Horticulture	Jiwan Palta	Faculty	Potato
University of Wisconsin, Madison	Department of Horticulture	Jiming Jiang	Faculty	Potato
University of Wisconsin, Madison	Department of Horticulture	Shelley Jansky	Faculty	Potato
University of Wisconsin, Madison	Department of Horticulture	John Bamberg	Faculty	Potato
University of Wisconsin, Madison	Department of Horticulture	James Nienhuis	Faculty	Snap bean

Institution	Department	Name	Position	Crop
University of Wisconsin, Madison	Department of Agronomy	Molly Jahn	Faculty	Squash, pepper
University of Wisconsin, Madison	Department of Agronomy	Bill Tracy	Faculty	Sweet corn
University of Wisconsin, River Falls	Plant and Earth Science, Extension office	Brian R. Smith	Faculty	Blackice plum, strawberries, aronia, grape, plums, apricots, and cherries
University of Wyoming	Department of Plant Sciences	Sadanand A. Dhekney	Faculty	Grapevine
University of Wyoming	Department of Plant Sciences	Robin Groose	Faculty	Legumes, alfalfa, annual medic
Utah State University	Plants, Soils & Climate	David Hole	Faculty	Cereals
Utah State University	Plants, Soils & Climate	John Carman	Faculty	Grain
Utah State University	Plants, Soils & Climate	Jack E. Staub	Adjunct	Legume
Utah State University	Plants, Soils & Climate	Michael Peel	Adjunct	Legume
Utah State University	Plants, Soils & Climate	Joseph Robins	Adjunct	Orchard grass
Utah State University	Plants, Soils & Climate	Brent Black	Faculty	Raspberry, strawberry
Utah State University	Plants, Soils & Climate	Jianli Chen	Faculty	Small grains
Utah State University	Plants, Soils & Climate	Edward Souza	Adjunct	Wheat
Utah State University	Plants, Soils & Climate	Kevin Jensen	Adjunct	Wheatgrass, wildrye
Utah State University	Plants, Soils & Climate	Paul G. Johnson	Faculty	Wheatgrass, wildrye
Virginia Polytechnic Institute & State University	Department of Crop & Soil Environmental Sciences	Carl Griffey	Faculty	Barley, wheat
Virginia Polytechnic Institute & State University	Department of Horticulture	Kedong Da	Faculty	Lilies

Institution	Department	Name	Position	Crop
Virginia Polytechnic Institute & State University	Department of Horticulture	Richard Veilleux	Faculty	Potato, eggplant, strawberry
Virginia Polytechnic Institute & State University	Department of Crop & Soil Environmental Sciences	M. A. Saghai-Maroof	Faculty	Soybean
Virginia Polytechnic Institute & State University	Department of Crop & Soil Environmental Sciences	Bo Zhang	Faculty	Soybean
Virginia Polytechnic Institute & State University	Department of Crop & Soil Environmental Sciences	Carol A Wilkinson	Faculty	Tobacco
Virginia State University	College of Agriculture	Harbans Bhardwaj	Faculty	Rapeseed, canola
Washington State University	Department of Horticulture	Katherine M. Evans	Faculty	Apple
Washington State University	Department of Horticulture	Nnadozie Oraguzie	Faculty	Apple
Washington State University	Department of Horticulture	Stefano Musacchi	Faculty	Apple, peach, pear
Washington State University	Department of Crop and Soil Sciences	Kevin Murphy	Faculty	Barley
Washington State University	Department of Crop and Soil Sciences	Ian Cristofer Burke	Faculty	Camelina
Washington State University	Department of Crop and Soil Sciences	Scot H. Hulbert	Faculty	Camelina
Washington State University	Department of Crop and Soil Sciences	Sachin Rustgi	Faculty	Cereals
Washington State University	Department of Horticulture	Matthew D. Whiting	Faculty	Cherry
Washington State University	Department of Horticulture	Lisa Wasko DeVetter	Faculty	Cranberry
Washington State University	Department of Horticulture	Carol Miles	Faculty	Eggplant, lettuce, tomato
Washington State University	Department of Crop and Soil Sciences	Kulvinder Gill	Faculty	Grain/wheat
Washington State University	Department of Horticulture	Markus Keller	Faculty	Grape (juice & wine)
Washington State University	Department of Horticulture	Liqun Du	Faculty	Mustard and others
Washington State University	Department of Horticulture	B.W. (Joe) Poovaiah	Faculty	Mustard and others

Institution	Department	Name	Position	Crop
Washington State University	Department of Horticulture	Desmond R. Layne	Faculty	Peach
Washington State University	Department of Horticulture	Cameron P. Pearce	Faculty	Peach, strawberry
Washington State University	Department of Horticulture	Mark J. Pavek	Faculty	Potato
Washington State University	Department of Horticulture	N. Richard Knowles	Faculty	Potato
Washington State University	Department of Horticulture	Patrick Moore	Faculty	Raspberry, strawberry
Washington State University	Department of Crop and Soil Sciences	Michael O. Pumphrey	Faculty	Wheat
Washington State University	Department of Crop and Soil Sciences	Kimberlee Kae Kidwell	Faculty	Wheat
Washington State University	Department of Crop and Soil Sciences	Stephen S. Jones	Faculty	Wheat
Washington State University	Department of Crop and Soil Sciences	E. Patrick Fuerst	Faculty	Wheat
Washington State University	Department of Crop and Soil Sciences	Arron H. Carter	Faculty	Wheat
West Texas A&M University	Agriculture	Brock C Blaser	Faculty	Grain, fiber, oilseed
West Virginia State University	Biology	Umesh K. Reddy	Faculty	Melon
West Virginia State University	Biology	Padma Nimmakayala	Faculty	Melon, sweet potato, peppers
West Virginia State University	Biology	Barbara Liedl	Faculty	Tomato
West Virginia University	College of Agriculture, Natural Resources and Design, Division of Plant and Soil Sciences	Vagner A. Benedito	Faculty	Unclear
West Virginia University	College of Agriculture, Natural Resources and Design, Division of Plant and Soil Sciences	Matthew A. Jenks	Faculty	Unclear
West Virginia University	College of Agriculture, Natural Resources and Design, Division of Plant and Soil Sciences	Alan R. Biggs	Faculty	Soybean, apple
Western Illinois University	School of Agriculture	Win Phippen	Faculty	(Field) pennycress
Western Illinois University	School of Agriculture	Joel Gruver	Faculty	Radish

Institutional Research

STPI was asked to examine the number of students receiving training in plant breeding. This question is difficult to answer precisely due to the large variation in how schools define their majors. In addition, many schools do not track the number of degrees received by major, and instead report at the college level. Tables A-4 through A-6 show these data, which were obtained from 77 land-grant institutions and 24 non-land-grant institutions. STPI research staff were unable to obtain data from 37 land-grant institutions and 13 non-land-grant institutions.

The degrees awarded for horticulture were collected only for institutions that offered horticulture degrees but did not offer any of the other plant breeding-related degree areas (e.g. Plant Science and Agronomy). Horticulture programs usually focus on gardening and landscaping rather than on plant breeding, so horticulture degrees were not counted unless they were the only plant breeding-related major found.

The following institutions were not able to provide data at the degree level.

- Cornell—no bachelor's degree data available
- Missouri State University
- Navajo Technical College
- Northwest Missouri State University
- University of California, Davis
- University of Arizona
- University of Tennessee (Martin)

No institutional research data were found for the following institutions:

- Aaniiih Nakoda College
- Abraham Baldwin College
- Bay Mills Community College
- Blackfeet Community College
- Cankdeska Cikana Community College
- Central Lakes College, Staples Campus
- Chief Dull Knife Community
- College of Menominee Nation
- College of the Muscogee Nation
- Community College of Micronesia

- Delaware Valley University
- Dine College
- Duke
- Florida International University
- Fond Du Lac Tribal & Community College
- Fort Berthold Community College
- Fort Hays State University
- Ilisagvik College
- Lac Courte Oreilles Ojibwa Community College
- Little Big Horn Community College
- Morrisville State College
- Nebraska Indian Community College
- Northern Marianas College
- Northwest Indian College
- Oglala Lakota College
- Si Tanka/Huron University
- Sinte Gleska University
- Sisseton Wahpeton Community College
- Tohono O'Odham Community
- Turtle Mountain Community College
- Tuskegee University
- University of the Pacific
- White Earth Tribal and Community College
- Wilmington College Ohioyes

Table A-4. Numbers of Bachelor's Degrees Awarded in the Most Recent Year for Fields Related to Plant Breeding

Field	Number of Degrees
Agriculture	3,379
Alabama A&M University	5
Alcorn State University	2
Auburn University	12
Cornell University	514
Delaware State University	15
Dickinson State University	11
Eastern Kentucky University	26
Florida A&M University	46
Lincoln University	14
Missouri State University	103
Murray State University	62
Prairie View A&M University	24
South Dakota State University	268
Southern University and A&M College	14
Texas A&M University	1,116
University of Arizona	678
University of Arkansas at Pine Bluff	17
University of Connecticut	18
University of Guam	5
University of Maine	6
University of Maryland Eastern Shore	16
University of Minnesota- Crookston	7
University of Vermont	5
University of Wisconsin-Platteville	115
University of Wisconsin-River Falls	13
University of Wisconsin-Stevens Point	22
Utah State University	12
Virginia Polytechnic Institute & State University	22
Virginia State University	18
West Texas A&M University	87
Western Illinois University	106

Field	Number of Degrees
Agronomy	331
Iowa State University	79
Kansas State University	52
Michigan State University	91
New Mexico State University	5
University of Georgia	7
University of Minnesota- Crookston	18
University of Nebraska	55
University of Wisconsin-Madison	15
University of Wyoming	5
West Virginia University	4
Crop Science	375
Auburn University	62
Clemson University	6
Colorado State University	41
Illinois State University	21
North Dakota State University	60
Oregon State University	22
University of Arkansas	34
University of Illinois	100
University of Wisconsin-River Falls	13
Virginia Polytechnic Institute & State University	16
Environmental Science	39
Fort Peck Community College	1
Haskell Indian Nations University	8
Little Priest Tribal College	1
University of Alaska	1
University of Rhode Island	26
University of the District of Columbia	2
Horticulture	53
Oregon State University	40
University of Connecticut	13
Plant Breeding	5
Colorado State University	1
Purdue University	4

Field	Number of Degrees
Plant Science	1,060
Alabama A&M University	1
Fort Valley State University	12
Louisiana State University	8
Mississippi State University	25
Montana State University	27
North Carolina State University	30
Ohio State University	62
Oklahoma State University	19
Rutgers, The State University of New Jersey	13
Southern Illinois University	46
Tarleton State University	8
Tennessee State University	3
Texas Tech University	27
University of California, Riverside	8
University of Florida	96
University of Georgia	5
University of Hawaii	15
University of Idaho	13
University of Kentucky	7
University of Maryland (at College Park)	136
University of Massachusetts, Amherst	38
University of Missouri	28
University of New Hampshire	2
University of Tennessee (Knoxville)	363
University of Vermont	2
Utah State University	35
Washington State University	31

Table A-5. Numbers of Master's Degrees Awarded in the Most Recent Year for Fields Related to Plant Breeding

Field	Number of Degrees
Agriculture	448
Alcorn State University	4
Cornell University	64
Delaware State University	3
Florida A&M University	9
Mississippi State University	35
Missouri State University	8
Murray State University	16
New Mexico State University	6
South Dakota State University	18
Stephen F. Austin State University	7
Texas A&M University	184
Tufts University	16
University of Arizona	58
Washington State University	6
West Texas A&M University	14
Agronomy	61
Illinois State University	1
Iowa State University	23
Kansas State University	11
Michigan State University	3
University of Nebraska	13
University of Wisconsin-Madison	4
West Virginia University	6
Crop Science	78
Auburn University	14
Colorado State University	8
Louisiana State University	1
Cornell University	1
North Carolina State University	11
Oregon State University	2
University of Arkansas	13
University of Georgia	7
University of Illinois	9
Virginia Polytechnic Institute & State University	9
Washington State University	3

Field	Number of Degrees
Environmental Science	9
Lincoln University	4
University of Guam	5
Oregon State University	9
University of Florida	34
Plant Breeding	15
Cornell University	1
Iowa State University	6
University of Georgia	4
University of Maryland (at College Park)	2
University of Wisconsin-Madison	2
Plant Genetics	2
Michigan State University	2
Plant Science	254
Clemson University	12
Montana State University	2
New Mexico State University	8
North Carolina A&T State University	10
North Carolina State University	1
North Dakota State University	9
Ohio State University	2
Oklahoma State University	5
Southern Illinois University	10
Tennessee State University	6
Texas Tech University	17
University of California, Riverside	5
University of Connecticut	34
University of Georgia	1
University of Hawaii	4
University of Idaho	10
University of Kentucky	3
University of Maine	4
University of Maryland (at College Park)	60
University of Massachusetts, Amherst	5
University of Missouri	18
University of Tennessee (Knoxville)	13
University of Vermont	6
Utah State University	8
Virginia State University	1

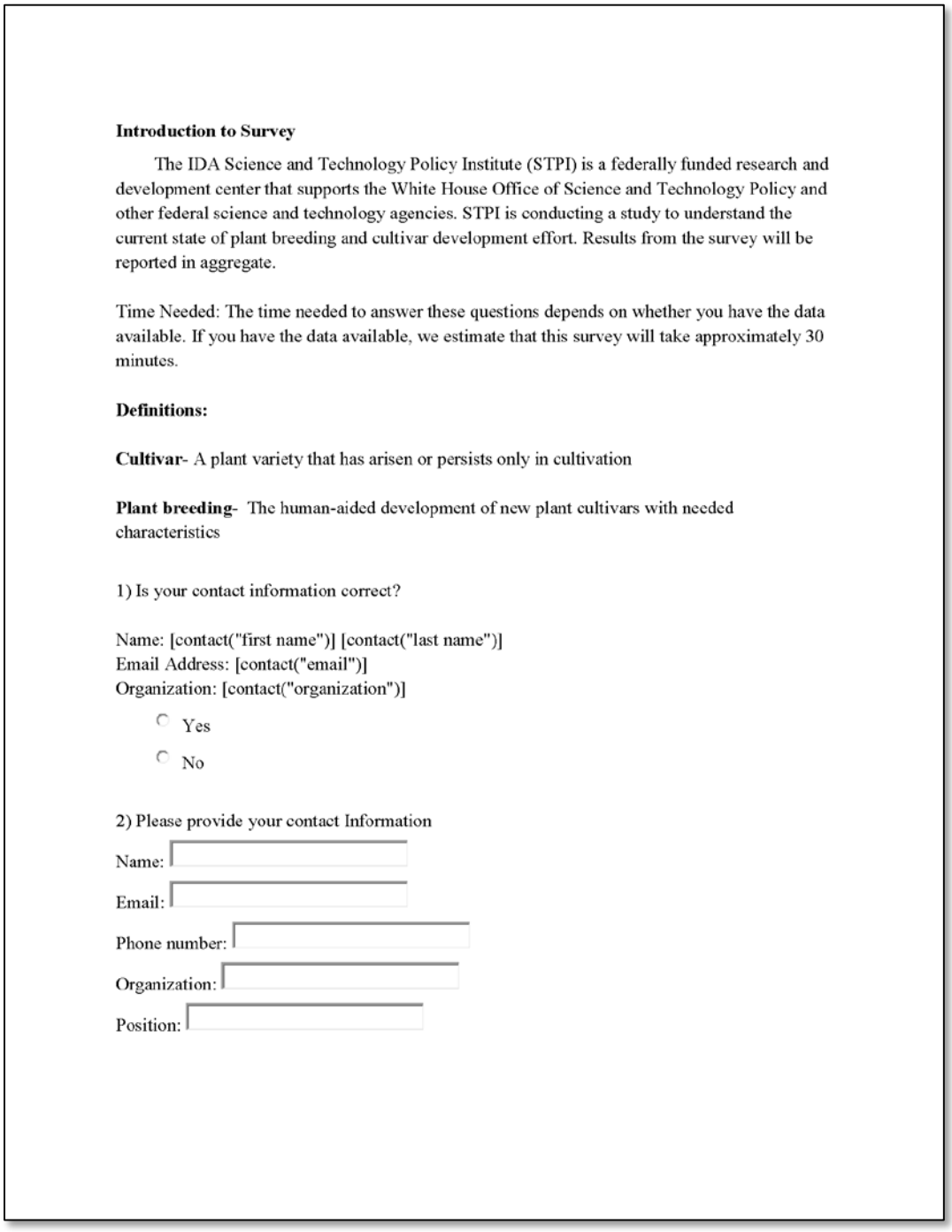
Table A-6. PhD Degrees Awarded in the Most Recent Year for Fields Related to Plant Breeding

Field	Number of Degrees
Agriculture	161
Cornell University	45
Mississippi State University	3
South Dakota State University	7
Southern Illinois University	2
Texas A&M University	67
University of Arizona	34
West Texas A&M University	3
Agronomy	23
Kansas State University	7
Michigan State University	6
University of Nebraska	9
University of Wisconsin-Madison	1
Crop Science	46
Auburn University	4
Colorado State University	4
Cornell University	1
Louisiana State University	3
North Carolina State University	7
Oklahoma State University	4
Oregon State University	3
University of Arkansas	4
University of Georgia	3
University of Illinois	7
Virginia Polytechnic Institute & State University	3
Washington State University	3
Environmental Science	2
University of Rhode Island	2
Horticulture	57
University of Florida	57
Plant Breeding	20
Cornell University	5
Iowa State University	2
University of Georgia	4
University of Wisconsin-Madison	9

Field	Number of Degrees
Plant Genetics	13
Michigan State University	13
Plant Science	109
Alabama A&M University	8
Clemson University	8
Montana State University	1
New Mexico State University	5
North Carolina State University	3
North Dakota State University	7
Ohio State University	3
Texas Tech University	5
University of California, Riverside	11
University of Connecticut	18
University of Georgia	4
University of Hawaii	2
University of Idaho	4
University of Kentucky	3
University of Massachusetts, Amherst	7
University of Missouri	6
University of New Hampshire	3
University of Tennessee (Knoxville)	3
University of Vermont	5
Utah State University	2
West Virginia University	1

Appendix B.
Private Sector Survey Documentation

Survey Instrument



Introduction to Survey

The IDA Science and Technology Policy Institute (STPI) is a federally funded research and development center that supports the White House Office of Science and Technology Policy and other federal science and technology agencies. STPI is conducting a study to understand the current state of plant breeding and cultivar development effort. Results from the survey will be reported in aggregate.

Time Needed: The time needed to answer these questions depends on whether you have the data available. If you have the data available, we estimate that this survey will take approximately 30 minutes.

Definitions:

Cultivar- A plant variety that has arisen or persists only in cultivation

Plant breeding- The human-aided development of new plant cultivars with needed characteristics

1) Is your contact information correct?

Name: [contact("first name")] [contact("last name")]
Email Address: [contact("email")]
Organization: [contact("organization")]

- ○ Yes
- ○ No

2) Please provide your contact Information

Name:
Email:
Phone number:
Organization:
Position:

Plant breeding employment and hiring

For the questions below, we are interested in PhD-level plant breeders that develop commercial cultivars. We are interested in plant breeders that work on all cultivars, regardless of whether they are commodity crops, horticultural crops, etc.

Please do NOT include PhD-level employees that work solely in molecular biology, genetic analysis, or data analysis.

3) How many PhD-level plant breeders does your company currently employ world-wide?

4) Of the number of PhD-level plant breeders listed above, how many are employed within the United States?

5) How many PhD-level plant breeders do you anticipate hiring over the next 12 months world-wide?

6) Of the number of PhD-level plant breeders you anticipate hiring over the next 12 months, how many will be for positions within the United States?

7) What is the typical annual salary for entry-level PhD plant breeders at your company?

- ○ Below $60,000
- ○ Between $60,000 and $80,000
- ○ Between $80,000 and $100,000
- ○ Between $100,000 and $120,000
- ○ Between $120,000 and $140,000
- ○ Above $140,000
- ○ I don't know

8) How much do you agree or disagree with the following statements:

	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
We are hiring fewer plant breeders this year than on average in the past.	○	○	○	○	○
We have enough qualified applicants for entry-level plant breeding positions.	○	○	○	○	○

9) Does your company currently offer any fellowships or scholarships for undergraduate students, graduate students, or post-doctoral researchers pursuing plant breeding at colleges or universities?

○ Yes

○ No

10) Please briefly describe the fellowship(s) or scholarship(s) and the support that they provide.

Cultivar development programs

11) Indicate the classes of crops for which your company has cultivar development programs.

- ☐ Agave
- ☐ Almond
- ☐ Apple
- ☐ Apricot
- ☐ Banana
- ☐ Barley
- ☐ Beans (dry)
- ☐ Beans (fresh, fresh-processed)
- ☐ Blueberry
- ☐ Canola
- ☐ Carrot
- ☐ Cassava (or manioc)
- ☐ Castor
- ☐ Cherry
- ☐ Chinese tallow
- ☐ Coconut
- ☐ Cole crops (includes cabbage, kale, broccoli, Brussels sprouts, cauliflower, kohlrabi)
- ☐ Corn (not including sweetcorn)

- [ ] Cotton, other
- [ ] Cottonseed (for meal, oil, etc.)
- [ ] Crambe
- [ ] Cranberry
- [ ] Cucumber
- [ ] Cucurbits, other (includes pumpkin, squash, gourd)
- [ ] Cuphea
- [ ] Date
- [ ] Durum wheat
- [ ] Eggplant
- [ ] Filbert
- [ ] Flax
- [ ] Grain sorghum
- [ ] Grapefruit
- [ ] Greens and leafy vegetables (includes endive, lettuce, spinach, turnip-greens, celery, rhubarb, parsley, asparagus)
- [ ] Hard red spring wheat
- [ ] Hard red winter wheat
- [ ] Hard white wheat (includes club, western)
- [ ] Hemp
- [ ] Jojoba
- [ ] Kenaf
- [ ] Kiwi
- [ ] Lemon
- [ ] Lentil
- [ ] Lesquerella
- [ ] Long fiber cotton

- [ ] Mango
- [ ] Meadowfoam
- [ ] Melons (includes cantaloupe, muskmelon, watermelon)
- [ ] Mushrooms and other edible fungi
- [ ] Nectarine
- [ ] Oats
- [ ] Onion, garlic, leek, shallot
- [ ] Orange
- [ ] Ornamentals and Turf
- [ ] Palm
- [ ] Papaya
- [ ] Pasture and Forage Crops
- [ ] Peach
- [ ] Peanut
- [ ] Pear
- [ ] Peas (dry)
- [ ] Peas (fresh, fresh-processed)
- [ ] Pecan
- [ ] Peppers
- [ ] Pineapple
- [ ] Plum
- [ ] Popcorn
- [ ] Potato
- [ ] Raisin grapes
- [ ] Ramie
- [ ] Rape
- [ ] Raspberry

- [ ] Rice
- [ ] Rye
- [ ] Safflower
- [ ] Sesame
- [ ] Soft red wheat
- [ ] Soft white wheat
- [ ] Soybean
- [ ] Strawberry
- [ ] Sugar beet
- [ ] Sugar cane
- [ ] Sunflower
- [ ] Sweet potato
- [ ] Sweet sorghum
- [ ] Sweetcorn
- [ ] Table grapes
- [ ] Taro
- [ ] Tobacco
- [ ] Tomato
- [ ] Tung
- [ ] Upland cotton
- [ ] Walnut
- [ ] Wine grapes
- [ ] Yam

Comments:

12) Are there any crops for which your company has cultivar development programs that you didn't see in the question above?

- ○ Yes
- ○ No
- ○ I don't know

13) Please list the additional crops for which your company has cultivar development efforts.

14) Is there is anything else that you would like to tell us? If so, please describe in the box below.

15) Are you ready to submit your answers?

- ○ Yes, I am ready to submit my answers
- ○ No, I would like to revisit the survey at a later time

Thank You!

Thank you so much for taking the time to complete this survey. Your response is very important in providing a complete picture of plant breeding employment.

Companies Surveyed

The companies that were contacted with the private sector plant breeding survey are as follows:

- Ag Alumni Seed
- AgReliant Genetics, LLC
- American Takii, Inc.
- Ball Horticultural Company
- Bayer AG, Crop Science
- Beck's Hybrids
- BioDiagnostics, Inc.
- Dow AgroSciences
- DuPont Pioneer
- Enza Zaden
- HAPI-O (Honda-Innovation)
- HM Clause
- KWS Saat
- Illinois Foundation Seeds, Inc.
- Monsanto
- NuSeed Americas
- Peterson Genetics, Inc.
- Professional Seed Research, Inc.
- RiceTec, Inc.
- Sakata
- Syngenta Corporation

Crops Represented

Table B-1 lists the crops worked on by the private sector companies that submitted survey responses.

Table B-1. Crops Represented by Companies

Crop	Number of Companies
Barley	2
Beans (dry)	2
Beans (fresh, fresh-processed)	3
Canola	5
Carrot	4
Cole crops (includes cabbage, kale, broccoli, Brussels sprouts, cauliflower, kohlrabi)	5
Corn (not including sweetcorn)	6
Cotton, other	2
Cucumber	4
Cucurbits, other (includes pumpkin, squash, gourd)	5
Durum wheat	3
Eggplant	1
Grain sorghum	4
Greens and leafy vegetables (includes endive, lettuce, spinach, turnip-greens, celery, rhubarb, parsley, and asparagus)	5
Hard red spring wheat	5
Hard red winter wheat	5
Hard white wheat (includes club, western)	3
Lentil	1
Long fiber cotton	3
Melons (includes cantaloupe, muskmelon, and watermelon)	5
Oats	1
Onion, garlic, leek, and shallot	4
Ornamentals and turf	2
Pasture and forage crops	3
Pearl millet	1
Peas (fresh, fresh-processed)	2
Peppers	3
Popcorn	1
Potato	1
Radish	1
Rape	3
Rice	4
Soft red wheat	5
Soft white wheat	5
Soybean	6

Crop	Number of Companies
Sugar beet	2
Sugar cane	1
Sunflower	5
Sweet sorghum	1
Sweetcorn	3
Table beets	1
Tomato	5
Upland cotton	2

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Abbreviations

CRIS	Current Research Information System
HBCU	Historically Black Colleges and Universities
IDA	Institute for Defense Analyses
NACPB	National Association of Commercial Plant Breeders
NSF	National Science Foundation
SAES	State Agricultural Experiment Station
STPI	Science and Technology Policy Institute
USDA	United States Department of Agriculture

REPORT DOCUMENTATION PAGE

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14. ABSTRACT

The White House Office of Science and Technology Policy requested that the IDA Science and Technology Policy Institute (STPI) examine (1) the current state of plant breeding in the public and private sectors and (2) the educational pipeline for plant breeding. To determine the number of professional plant breeders and the crops that they work with, STPI research staff developed and sent a survey to heads of plant breeding departments and colleges at academic institutions and to private sector companies in the United States. In total, STPI received 82 completed surveys from 70 academic institutions and 14 completed surveys from private sector companies. In addition to gathering information via surveys, STPI research staff collected institutional research data and conducted interviews. This research builds upon previous surveys of public sector plant breeders done in 1994, 2001, and 2013, which were led by Kenneth Frey, Greg Traxler, and Thomas E. Carter, Jr., respectively.

15. SUBJECT TERMS

plant breeding; agriculture; state agricultural experiment stations; Land grant institutions

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