

THE ARBORETUM AT PENN STATE

Plant Records Manual



11-7-2017

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I. Introduction

Complete and accurate plant records are a defining feature of arboreta and botanic gardens. Excellent plant records allow an institution to maintain and care for its living collections and use the collections to support its educational, conservational, research, and aesthetic goals. Managing records associated with living collections creates a historical database that provides for future collection planning and preserves the information in history.

This manual provides an overview of the plant records database and how it is used to manage the Arboretum at Penn State's plant records. It outlines the procedures associated with documentation of living collections including accessioning, labeling, and mapping. It also supplies staff with the standards and formats associated with these procedures, examples of forms and documents, and a complete reference list for supplies and services. This manual should be used as a resource for staff, interns, and volunteers.

At the Arboretum, plant records management directly supports the concepts outlined in the Living Collections Policy Version 1.4. Please review this document for more information about the Arboretum's mission and vision and the policy's purpose and objectives.

II. The Plant Records Database

Plant records management begins with the ability to record and access information associated with the living collections. The Arboretum uses a collection management software called IrisBG. IrisBG is a comprehensive, relational database system that is housed on a SQL server at the University. The software can store an extensive amount of information on living and herbarium collections such as plant history, taxonomy, locations, maps, images, references, and contacts. Users can import and export data, create labels, run reports, and publish collections information and maps to the internet.

This manual describes the features of IrisBG that are important to plant records management at the Arboretum and how to use them. As the Arboretum's capacity for information grows, more IrisBG features will be utilized. For more information about IrisBG or for user support, visit <http://www.irisbg.com/>.

III. Accessioning Procedures

Accessioning is the process by which plants or groups of plants are given a unique accession number. This number is used to record information associated with that accession in the plant records database. Plants that are acquired for inclusion in the living collections or used for more

than one growing season are given an accession number and recorded in IrisBG. Annuals and other plants treated as such are not accessioned. The accessioning process includes four steps, which are described in the following sections (Figure 1).

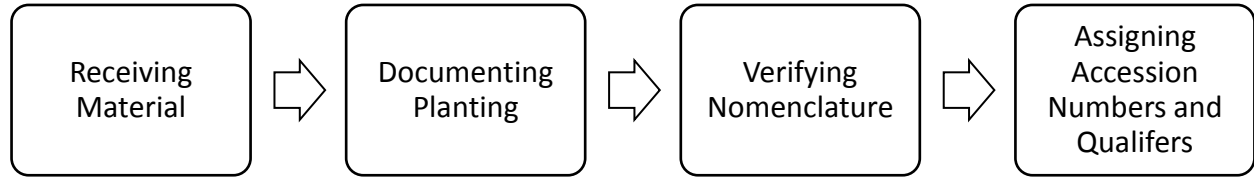


Figure 1: Accessioning Process

a. Receiving Plant Material

Purchased Material

Plant material is ordered and received through the University's Office of Physical Plant (OPP) or by the director of horticulture/curator. All plant material is delivered to the University's greenhouse/nursery at the Tower Road Landscape Facility. Invoices and/or packing slips received at the facility are given to the Horticulture/Plant Records office for accessioning purposes. Invoices are vital to the accessioning process because they contain the following information:

- Source name (greenhouse/nursery)
- Plant name
- Quantity
- Size of container or plant
- Type of material (plant, bulb, seed, etc.)
- Cost

The greenhouse manager or the director of horticulture/curator writes the received date and any comments on the top of the invoice. New invoices are kept in the front of the Plant Receiving binder until the information is recorded in IrisBG during accessioning. The plant records coordinator initials and dates the invoices in the upper right hand corner to acknowledge that the information has been entered into IrisBG. Invoices are then logged by the date received, starting with the most current date.

Donated Material

If plant material is donated to the Arboretum from a greenhouse/nursery, an invoice will be included as if the material was purchased. If the donated material comes from a private

individual, the director of horticulture/curator or the director of development will give the following information to the plant records coordinator:

- Name of person donating material
- Address and contact information
- Plant name
- Quantity
- Size of container or plant
- Type of material
- Where and when the person originally acquired the material

b. Documenting Planting

Planting Lists

After plants are received and ready to be planted, the director of horticulture/curator or the plant records coordinator fills out a planting list (Appendix A). Planting lists contain pertinent information needed for the accessioning process, including:

- Name of plant
- Quantity
- Condition
- Location code
- Comments about the planting
- Gardener performing the planting
- Planting date
- Does it need a display label?
- Does it need an accession tag?
- Does it have an invoice?

Planting lists are used by the plant records coordinator to accession the plant material. After the information has been entered into IrisBG, the plant records coordinator initials and dates the list in the upper right hand corner and logs the list in the Planting Lists and Plans binder.

Planting Plans

Often planting plans or maps are created by the director of horticulture/curator and/or gardeners before material is received and planted. Current plans can be referenced in the Planting Lists and Plans binder. Once work is completed, finalized plans and maps are logged in the appropriate garden location folder in the map drawer. Plans are dated and initialed by the person who created the map or made the last revisions.

c. Verifying Nomenclature

Nomenclature verification ensures that all names recorded in IrisBG have been scrutinized using the same process and standards. Names received on plant material invoices are often not correct or complete and must be verified before accessioning new plant material or including in

Arboretum publications or materials. Please see Appendix B for the complete nomenclature verification process and related standards.

Taxa Fields in IrisBG

Verified names are stored in IrisBG under *Taxa* (Figure 2). IrisBG can store a great amount of information regarding names, but not all of the fields are currently used by the Arboretum. The following fields are completed when recording a verified name:

- Genus
- Species and author(s)
- Intraspecific name(s) and author(s) *if applicable*
- Cultivar and cultivar group *if applicable*
- Trade name *if applicable*
- Comments
- Common name and rank
- Life form
- Usage types
- Distribution
- Parentage information *if applicable*
- References

For the *distribution* field, the standard is to record the continent to which the plant is native. To support information about the Arboretum's collection of native Pennsylvania plants, it is also recorded if a plant is native to the state. Native ranges are recorded as codes:

- AS = Asia
- AU = Australia
- AF = Africa
- EU = Europe
- NA = North America
- PA = Pennsylvania
- SA = South America

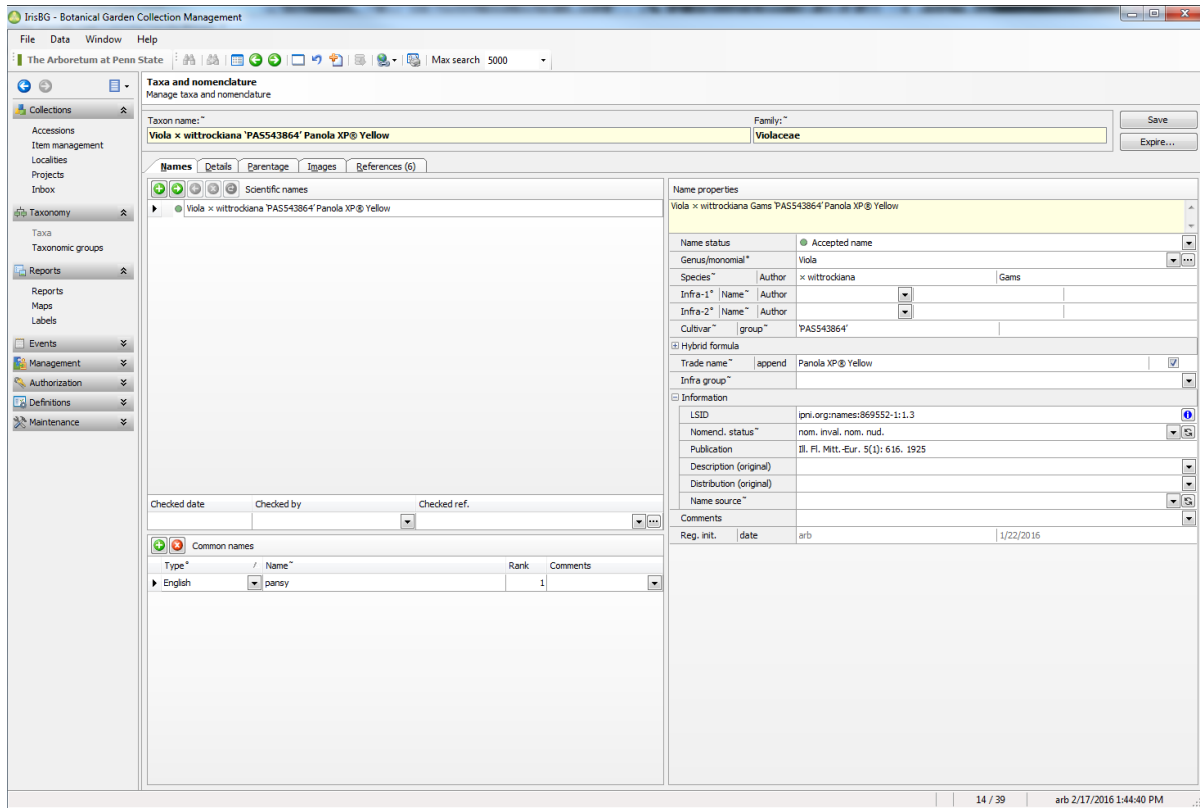


Figure 2: Taxa Table in IrisBG

For more information about recording taxa in IrisBG, please use the IrisBG User Guide in the Horticulture/Plant Records office or visit the IrisBG video tutorials page at http://www.irisbg.com/p_screencasts.aspx.

d. Assigning Accession Numbers and Qualifiers

Accession numbers consist of a nine digit number determined by the year in which the plant was received followed by the numerical order in which the plant was received during that year. The year and number are separated by a single dash (ex. 2009-0003). Accession numbers are assigned to:

- Individual plants
- Groups of plants if they are of the same name, were received at the same time, and obtained from the same source

Each plant or group of plants that are planted in separate locations are then given a distinct qualifier. Qualifiers consist of a two letter code starting with “AA”, “AB”, “AC”, etc. The accession number and qualifier are separated by an asterisk (ex. 2009-0003*AA). Qualifiers are assigned based on the location of the plant or group of plants with the same accession number starting with the plant or group of plants in the southernmost location of the gardens.

For example, if three plants with the same name were received at the same time from the same source, the plants are given the same accession number. Each plant is then assigned a unique qualifier based on its location starting with the southernmost plant (Figure 3).

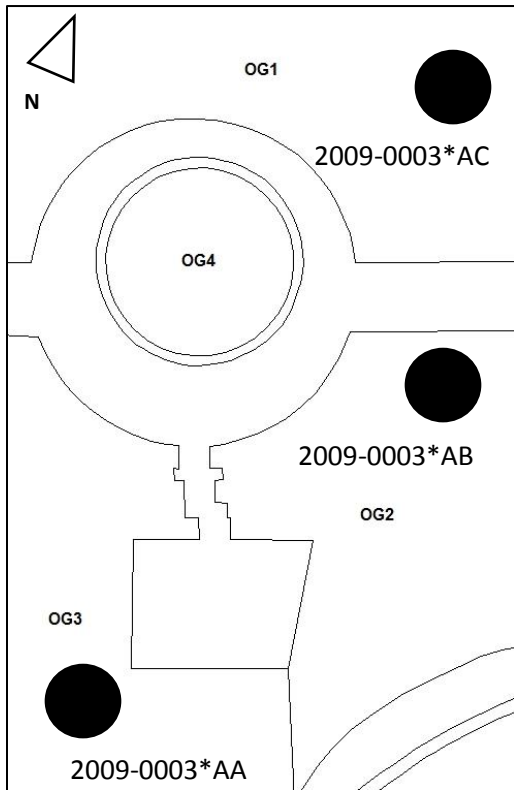


Figure 3: Example of Assigning Accession Numbers and Qualifiers

In this example, the plants were received in 2009 and were the third group of plants received. The southernmost plant is assigned the qualifier “AA”, the next southernmost is assigned “AB” and so on.

Individual vs. Separate Qualifiers

When assigning qualifiers to groups of plants with the same accession number, the growth habit of the plants must be considered. Some plants will remain distinguishable once planted,

such as trees and upright shrubs. Other plants will become indistinguishable once planted, such as root-suckering plants or herbaceous ground covers.

A group of plants is assigned a single qualifier if:

- They are planted as a mass in the same location AND
- Their growth habit makes them indistinguishable from each other

A group of plants is assigned separate qualifiers if:

- They are planted in separate locations OR
- They are planted as a mass in the same location, but their growth habit makes them distinguishable from each other

Accession Fields in IrisBG

Accessions are recorded in IrisBG under *Accessions* (Figure 4). The *Details* tab is used to record plant receiving information. The following fields are completed when recording a new accession:

- Taxon name
- Determination date
- Determination person
- Locality *if applicable*
- Received as name
- Contact (source)
- Provenance
- Propagation history
- Type
- Number of specimens
- Received date
- Received person
- Purpose
- Garden collection *if applicable*
- Received price
- Received size
- Received container
- Comments

The *Items* tab is used to record planting information and all future status updates. This is where accessions are assigned qualifiers. The following fields are recorded in the *Items* tab when recording a new accession:

- Qualifier
- Location
- Status
- Status date
- Number of specimens
- Condition
- Label type
- Label type OK
- Comments

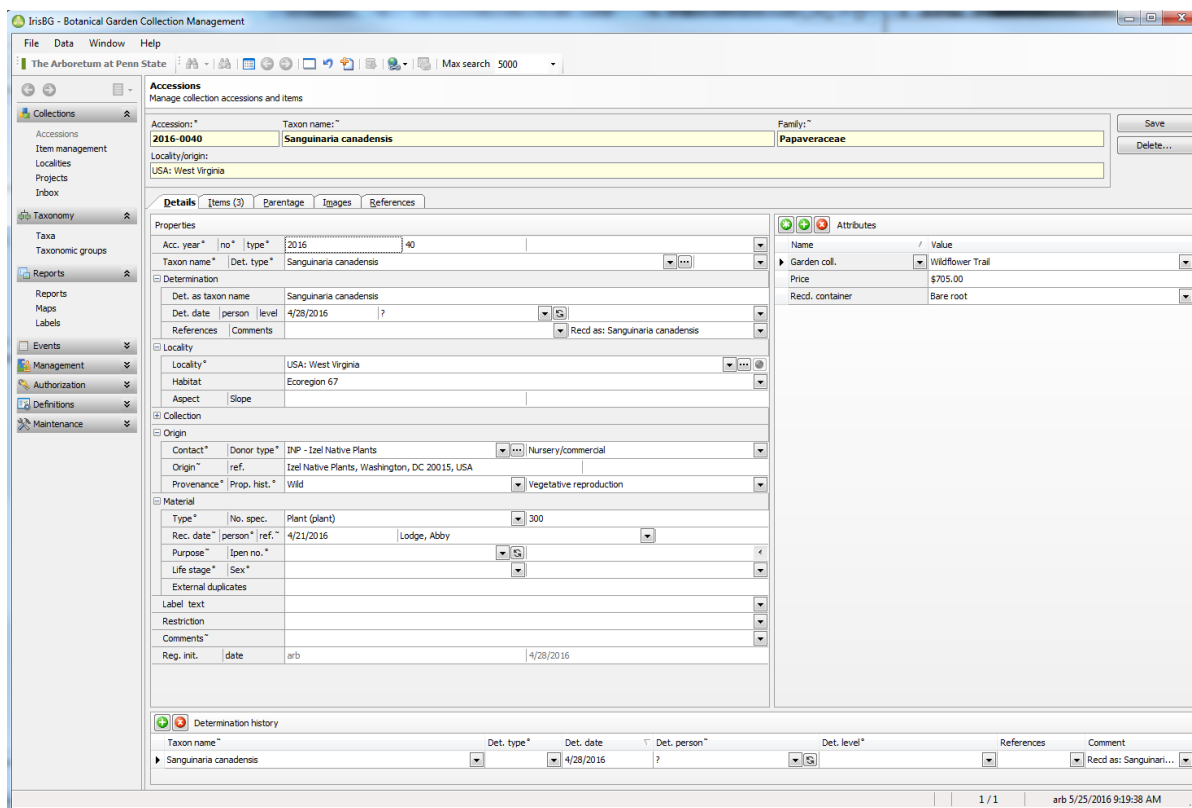


Figure 4: Accessions Table in IrisBG

For more information about recording accessions in IrisBG, please use the IrisBG User Guide in the Horticulture/Plant Records office or visit the IrisBG video tutorials page at http://www.irisbg.com/p_screencasts.aspx.

Pre-existing Plants

Pre-existing plants are plants that existed on the property prior to the organization of the Arboretum. Accession numbers for pre-existing plants begin with “0000” to represent the unknown year of germination or planting. The second number is based on the sequential order in which pre-existing plants are assigned accession numbers. For example, the accession number for a plant that is the third pre-existing plant to be accessioned would be 0000-0003*AA.

Wild or Garden Collections

Plant material of wild or garden origin that is collected by Arboretum staff for use in the living collections is accessioned. At the time of this writing, former accession collection procedures

are being evaluated and updated to meet current workflow and standards. The first draft of the new accession collection form (Appendix C) includes:

- Scientific name of plant
- Project name
- Location (country, state, county, township, local place name)
- Latitude/longitude
- Location description (slope, aspect, elevation, habitat)
- Origin
- Accession number of source plant *if applicable*
- Material type/quantity
- Name of collector
- Date of collection

This information is recorded in IrisBG under *Accessions* in the *Details* tab. The accession number for a plant collection is assigned based on the year during which it was collected. The second number is based on the sequential order in which plants were accessioned that year.

This section will be updated as the procedure for collecting accessions is evaluated and improved.

IV. Deaccessioning

Deaccessioning occurs when a plant is removed from the living collections, but the accession number and related information remains in the plant records database. Deaccessioned records are not deleted because they can provide important details for future planning.

When a plant is to be deaccessioned, the director of horticulture/curator notifies the plant records coordinator with a Plant Removal Report (Figure 5). The report includes as much information as possible about the reason for removal. The plant records coordinator uses the report to deaccession the plant in IrisBG. Deaccessioning occurs when the accession's status in the *Items* tab in IrisBG is updated to one of the following:

- Dead
- Dead- horticultural cause
- Dead- natural cause
- Not found
- Removed
- Given away
- Stolen
- Propagation failure
- Reaccessioned

<p>The Arboretum at Penn State – Plant Removal Report Date: _____</p> <p>Plant name: _____</p> <p>Accession #: _____ # plants: _____</p> <p>Collection: _____</p> <p>Location: _____</p> <p># plants remaining: _____</p> <p>Reason (circle one): Removal / Dead / Not found</p> <p>Plant: Remove(d) / Awaiting approval</p> <p>Stump: Remove(d) / Herbicide(d) / Leave (Left)</p> <p>Reported by: _____ Approved by: _____</p> <p>Removed by: _____ Removal Date: _____</p>	<p>The Arboretum at Penn State – Plant Removal Report</p> <p>Cause: Unknown / Known (please describe below)</p> <p>Description: Animal damage / Drought stress / Winter injury / Poor condition / Disease / Insect / Lightning damage / Storm / Construction / Space needs / Surplus / Not true to name / Other</p> <p>Comments:</p>
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Figure 5: Plant Removal Report (Front and Back)

Plants to be deaccessioned are also found during plant inventories conducted by the plant records coordinator. In this case, Plant Removal Reports are not necessary.

Reaccessioned

A record is considered reaccessioned when qualifiers are deaccessioned and added to another qualifier. This infrequent update occurs when a group of plants is mistakenly assigned individual qualifiers instead of a single qualifier.

V. Accession Tags

Accession tags are produced and installed in the gardens for all woody plants. Herbaceous plants are accessioned, but not identified by tags. The Arboretum staff use the tags to identify plants in the gardens during maintenance, inventory, and mapping. They are not intended for visitor use and are often not seen from the front of the garden beds. Tags include the verified scientific name, common name, and accession number (Figure 6).

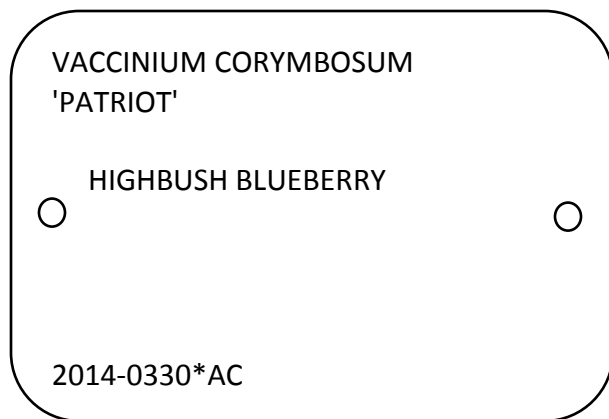


Figure 6: Example of an Accession Tag

The plant records coordinator makes the aluminum accession tags in-house using IrisBG, Microsoft Word and Notepad, and the Datacard machine. Please see Appendix D for more information about how to make accession tags and formatting standards.

Installation

Staked Tags

Staked tags are the standard accession tag used at the Arboretum. Accession tags are mounted with hardware on to aluminum stakes. Tags are mounted so that the information is read from top to bottom. They are installed with a rubber mallet into the ground directly behind the plant or group of plants in a garden bed (Figure 7). For plants that are not in a garden bed or near a path that indicates the view from which the plant will be seen, tags are installed on the southern side of the plant.



Figure 7: Staked Accession Tag in the Gardens (Full View and Close-up)

The following rules ensure accessibility and readability of accession tags after installation:

- Leave space between the accession tags and the ground to prevent the tags from being buried by soil or mulch.
- Do not place the accession tags too close to the center of a plant to ensure access to the tags while the plants continue to grow.
- For most plants, install the tags so that information is facing away from the plants because it is the most convenient way to read tags.
- For plants directly in front of walls or other barriers, install the tags so that the information is facing towards the plant (Figure 8). It is difficult to read labels that are facing a wall or barrier.



Figure 8: Staked Accession Tag near a Wall (Full View and Close-up)

Hang Tags

In some cases, staked tags are not appropriate for identifying accessions. Hang tags are used in the following scenarios:

- In garden beds that are prone to foot traffic because staked tags would impose a tripping hazard.
- In beds where staked tags would damage the buried drip-line irrigation.
- Where herbaceous ground covers would hide the accession tag for a woody specimen.

Hang tags are installed with a 14 inch long piece of thin black wire at eye level on a branch in the back of the plant (Figure 9). For plants that are not in a garden bed or near a path that indicates the view from which the plant will be seen, tags are installed on the southern side of

the plant. The wire is threaded so that the information is read from top to bottom. Only hang tags are used in the following locations:

- Poplar Court
- Field Landscape 3
- Housing and Food Services 1
- Children’s Garden 23, 26, 27, 28, 29, 30 and Aspen Story Circle



Figure 9: Hanging Accession Tag in the Gardens (Front and Back)

Please see Appendix E for a complete list of materials, specifications, and sources for producing accession tags.

VI. Plant Display Labels

Plant display labels are intended to display educational information about the living collections to visitors. Unlike accession tags, they are geared towards the public and face the front of all garden beds. Labels include the verified scientific name, common name, family, and native range of the identified plant (Figure 10). This information is recorded during the nomenclature verification process and can be found in the *Taxa* table in IrisBG.

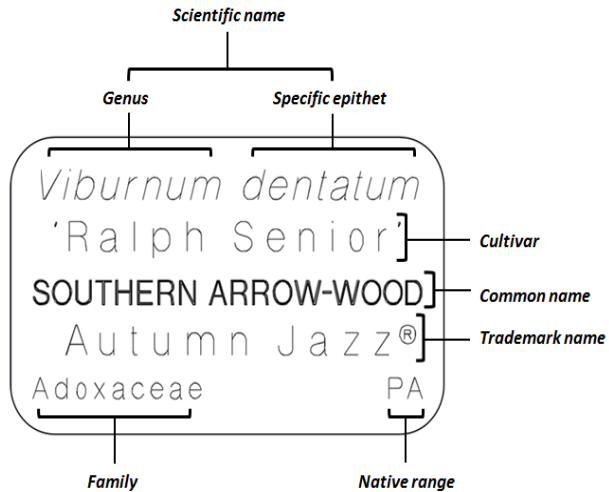


Figure 10: Elements of a Plant Display Label

The plant records coordinator makes plant display labels in-house using IrisBG, Gravostyle software, and the Gravograph machine. Please see the Arboretum's Guide to Gravostyle and Gravograph for directions and formatting standards for plant display labels.

Assembly

After labels are printed through Gravograph, they are mounted on to angled stakes with double-sided tape. The tape is cut and affixed to the angled part of the stake before labels are mounted (Figure 11). Stakes are cleaned with rubbing alcohol before tape is adhered. The prepared stakes are stored in the Horticulture/Plant Records office because they need to be in a controlled environment to adhere properly. The longer the tape is on a stake before label mounting, the longer it will last outside.



Figure 11: Prepared Stakes

After labels are printed, the corners are cut with a ¼ inch round corner cutter (Figure 12). The label is cleaned with rubbing alcohol and placed face down on the counter with one edge flush with the wall. The plant label stake template is placed on top of the label to indicate the center where the stake should be placed (Figure 13).

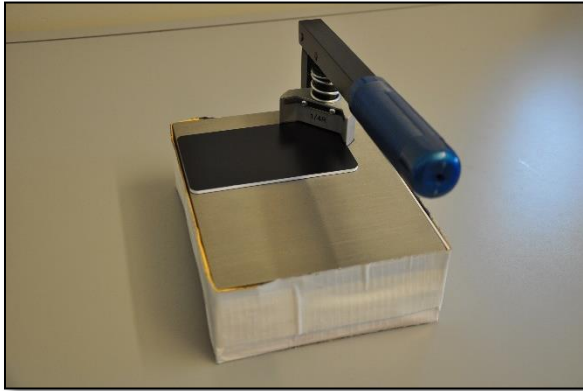


Figure 12: Corner Cutter with Plant Display Label



Figure 13: Label with Stake Template

There are three stake lengths: two, three, or four feet. Two foot stakes are the most commonly used, but longer stakes may be required for tall plants or plants that are behind other displays. The stake is placed face down on the back of the label, flush with the template and the top of the label (Figure 14). Labels are left in the office for at least one day to ensure adhesion. Please

see Appendix E for a complete list of materials, specifications, and sources for producing plant display labels.



Figure 14: Stake Placement on Label

Installation

Labels are installed parallel to the edge of the garden bed near the closest path. If there is no path that visitors are expected to use, the label is oriented so that it can be read from the most likely viewpoint. Labels are placed in front of and centered on the plant or group of plants that it is identifying and inserted into the ground to a height that complements the height of the plant. Stakes are not inserted by pressing down on the label portion because it puts stress on the tape. It is best to grip the stake under the label to push it into the ground. See Figure 15 for an example of a typical plant display label installation.



Figure 15: Plant Display Label in Gardens

VII. Mapping

Maps are the most reliable source for identifying plant and garden locations and are essential to managing and inventorying accessions. Two systems are used for mapping at the Arboretum: GPS mapping in the field and heads-up digitizing on the computer.

Field Mapping

The Arboretum's field mapping system and protocols were developed with assistance from the Alliance for Public Gardens GIS (APGG, <http://publicgardensgis.ucdavis.edu/>), Environmental Systems Research Institute (ESRI, <http://www.esri.com/>), and Pennsylvania Spatial Data Access (PASDA, <http://www.pasda.psu.edu/>). Mapping is conducted using an iPad with ESRI's Collector application (Figure 16). Collector can be downloaded for free, but requires an ArcGIS Online subscription to create custom maps for use in the application. A subscription is also needed to download data that is collected and saved to ArcGIS Online. PASDA provides the Arboretum with access to ArcGIS Online through Penn State Data Commons (<http://datacommons.maps.arcgis.com/home/index.html>) and support for producing maps used in Collector and on the web. As data is collected in Collector, it is simultaneously sent back to ArcGIS Online via cellular or wireless internet connection.

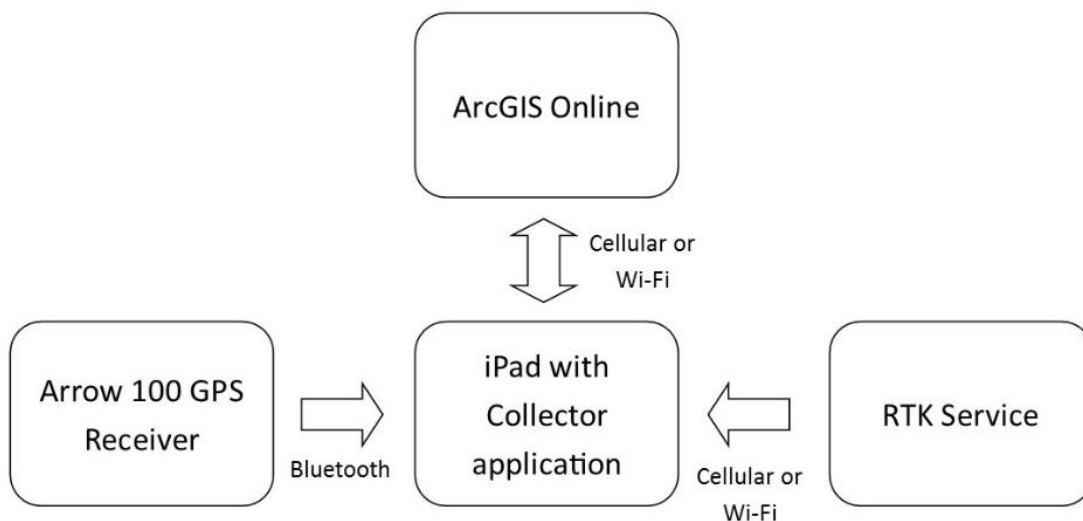


Figure 16: Field Mapping System

Collector can use the iPad's built-in location services to collect coordinate points, but to increase accuracy, it is connected to an EOS Arrow 100 GPS receiver via Bluetooth. Besides GPS satellites, the Arrow can utilize Satellite-Based Augmentation Systems (SBAS) for differential

corrections, which allows for 30 to 60 cm accuracy. To further increase location accuracy, Collector receives Real Time Kinematic (RTK) service from KeyNet GPS via cellular or wireless internet connection. When connected to RTK, accuracy increases to between 10 and 20 cm.

The chosen correction method determines the position output of the Arrow receiver (i.e. the datum in which the coordinate points are being received). When connected to RTK, the datum is NAD 1983 (2011). If only SBAS is used, the datum is ITRF 2008, current epoch. Maps used in Collector need to reference the correction method’s datum or use an on-the-fly datum transformation to prevent error (Table 1). Datum transformations are stored in Collector under *Settings* → *Location Profiles*.

Collector Map	Coordinate System	Correction Type	Datum Transformation
Plant Accessions	NAD 1983 (2011)	RTK	None
Prairie	NAD 1983 (2011)	RTK	None
Hartley Wood	NAD 1983 (2011)	SBAS	ITRF 2008 to NAD 1983 2011

Table 1: Coordinate Systems and Correction Types for Current Collector Maps

Heads-up Digitizing

Heads-up digitizing is used for mapping garden beds, walkways, trails, buildings, and other non-living features in the Arboretum. Digitizing is completed using ArcGIS for Desktop Advanced software and aerial imagery flown by the University’s Office of Physical Plant (OPP). OPP flies new imagery about every two years and makes it available to the public through PASDA’s website (<http://www.pasda.psu.edu/>). The most current imagery was flown in 2015.

For more information about the equipment and services needed for mapping, please see Appendix E.

Accessions

Accessions are mapped in the field using the field mapping system. The plant accessions map used in Collector was specifically designed by the Arboretum and includes the following fields for data collection (Figure 17):

- Accession year
- Accession number
- Accession item (qualifier)
- Comments

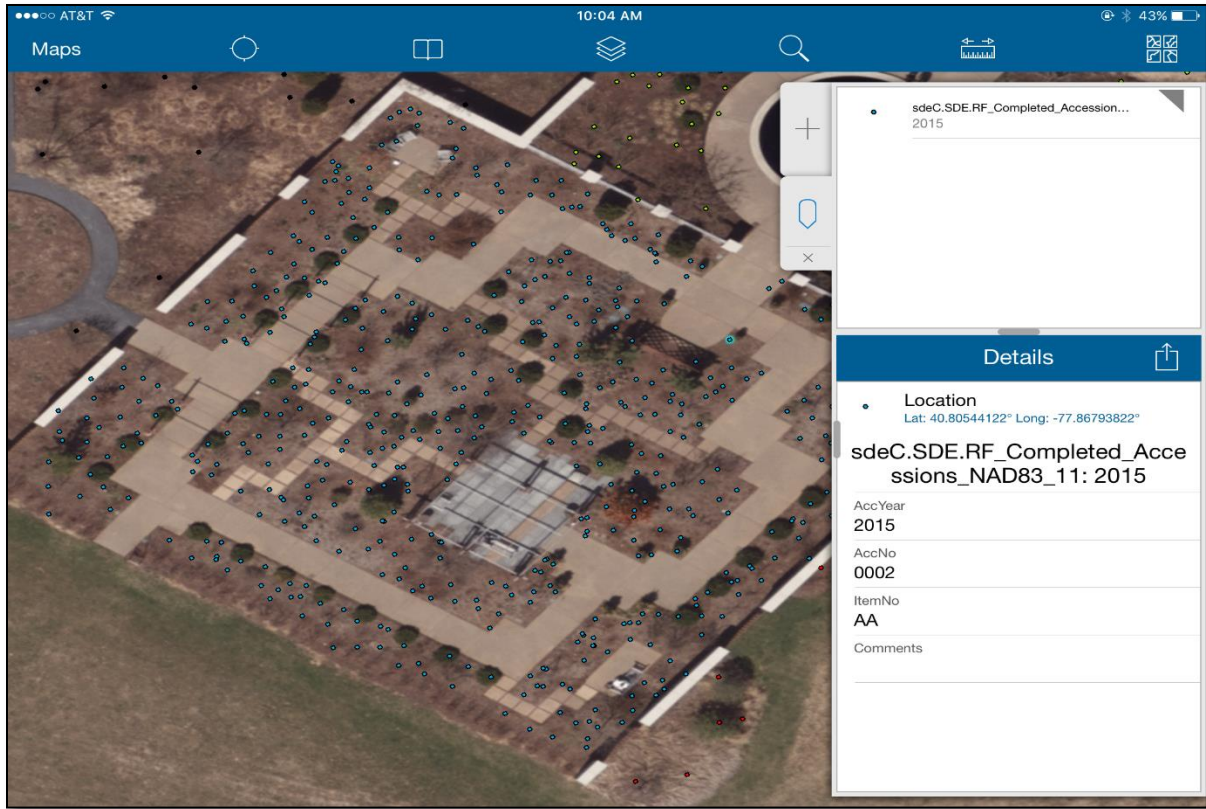


Figure 17: Screenshot of Accession Map in Collector

After collection in the field, accession coordinate points are exported from ArcGIS Online and imported into IrisBG (Figure 18). Please refer to Appendix F for technical directions to complete the accession mapping process.

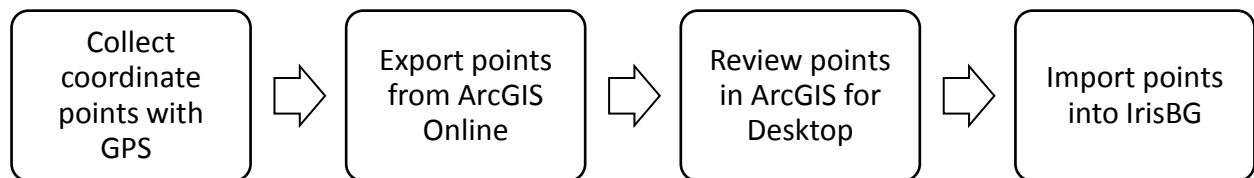


Figure 18: Accession Mapping Process

The Arboretum’s goal is to have all accessioned plants georeferenced using this system. A map of the accessions will be seamlessly integrated with IrisBG through a solution under

development by ESRI and IrisBG called IrisBG sync. Ultimately, a map of the living collections will be available to visitors through the Arboretum’s website.

Locations

Accessions are recorded in IrisBG using the location code that it is planted in as its primary location description. Location codes are made up of an abbreviation of the garden or location name and bed number (Table 2).

Name	Codes	Name	Codes
Annual/Perennial	AP1-AP4	Oasis Garden	OG1-OG3
Children’s Garden	CG1-CG34	Overlook Entry	OE1-OE2
Event Lawn	EL1-EL4	Overlook Pavilion	OP1-OP4
Field Landscape	FL1-FL3	Parking Lot	PL1-PL4
Fountain Garden	FG1-FG3	Pollinators’ Garden	PG1-PG5
Hartley Wood	HW1- HW6	Prairie Restoration	PR1-PR5
Housing/Food Services	HF1	Rose and Fragrance Garden	RF1-RF10
Marsh Meadow	MM1-MM2	Strolling Garden	SG1-SG6
North Terrace	NT1-NT3	Tower Road	TR1

Table 2: Location Names and Codes

All garden beds in the botanic gardens have been coded, mapped on paper, and heads-up digitized in ArcGIS for Desktop. The master garden beds map references NAD 1983 State Plane Pennsylvania North FIPS 3701 as the coordinate system, which is the preferred projected coordinate system for this area in Pennsylvania. Please refer to the packet of garden bed maps to identify bed locations.

Planting areas in Hartley Wood (HW1-HW6) and the prairie (PR1-PR5) are mapped using the field mapping system. Both maps use NAD 1983 (2011) as the coordinate system. RTK data is not used for mapping in Hartley Wood because service is inconsistent in forested areas. However, RTK service is accessible in the prairie because it is open to the sky. To calculate area (acres) for planting areas, data is projected in NAD 1983 State Plane Pennsylvania North FIPS 3701 in ArcGIS for Desktop.

In addition to mapping planting areas in Hartley Wood and the prairie, the Arboretum's goal is to develop an overlaying grid system. This will be particularly useful for locating accessions in these larger, less defined areas.

VIII. Pest Management Documentation

Another important element of plant records management is documenting the identification, treatment, and impacts of pests and diseases detected at the Arboretum.

Plant Diagnostic Reports

Samples of diseased plant material or insect pests are submitted to the Plant Disease Clinic or the Insect Identification Lab at the University:

Plant Disease Clinic
220 Buckhout Laboratory
University Park, PA 16802
<http://plantpath.psu.edu/facilities/plant-disease-clinic>

Insect Identification Lab
501 ASI Building
University Park, PA 16802
814-865-1896
<http://ento.psu.edu/extension>

Formal reports from the Plant Disease Clinic are emailed to the director of horticulture/curator or the gardener who submitted the sample (Appendix H). The plant records coordinator initials and dates the report in the upper right hand corner and logs it in the Plant Diagnostic Results binder. Typically, there are no written reports from the Insect Identification lab as the results are given via phone. Results from either source are recorded in the *comments* section of the *Items* tab in IrisBG (Figure 19). If there is a report number, it is also included.

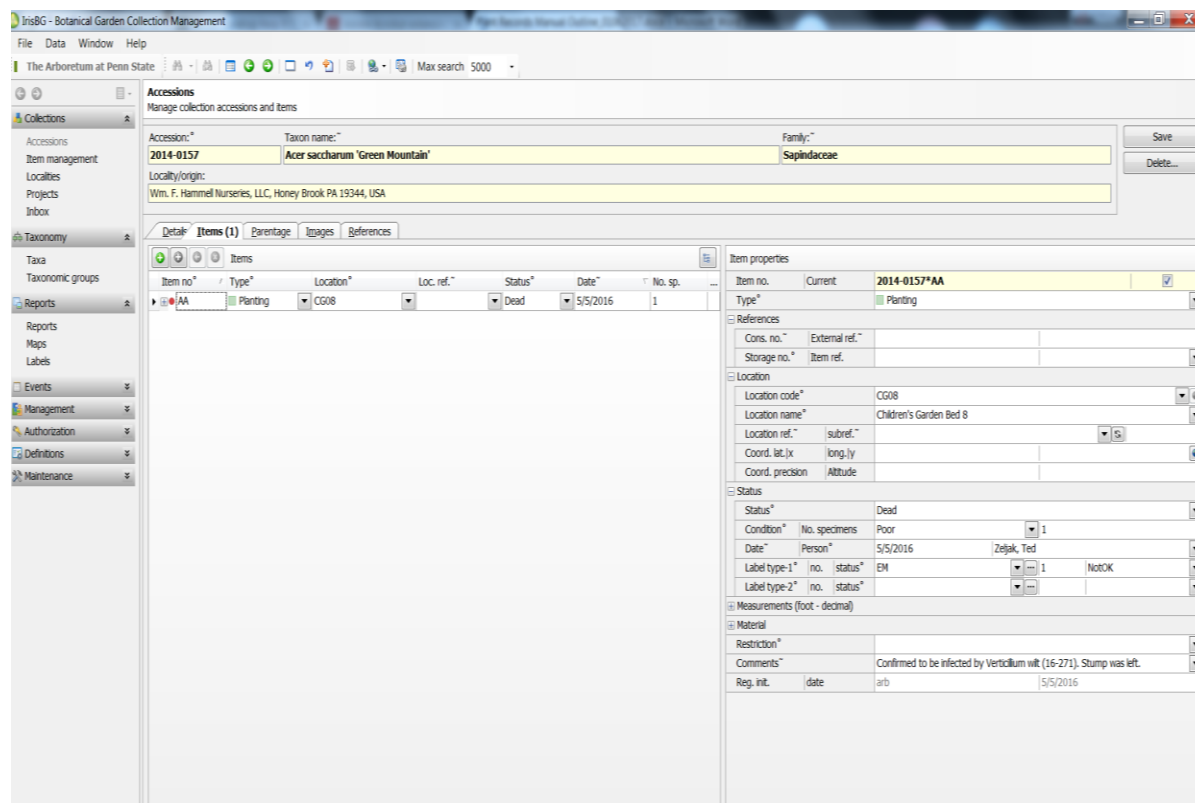


Figure 19: Plant Diagnostic Results in the Accessions Table

Identification results are often accompanied by a chemical application form and/or a plant removal report (section IV. Deaccessioning).

Chemical Application Forms

When chemical applications are required to manage a pest or disease, the gardeners are required by law and their work units to document the application (Appendix I). Chemical application forms include:

- Name and concentration of product
- Date and time of application
- Weather during application
- Name and ID number of applicator
- Treated area
- Targeted plants

Copies of these forms are given to the Horticulture/Plant Records office for documentation. When forms are received, the plant records coordinator records the application information in the *comments* section of the *Items* tab in IrisBG (Figure 20). Forms are then initialed and logged in the Chemical Storage and Applications binder.

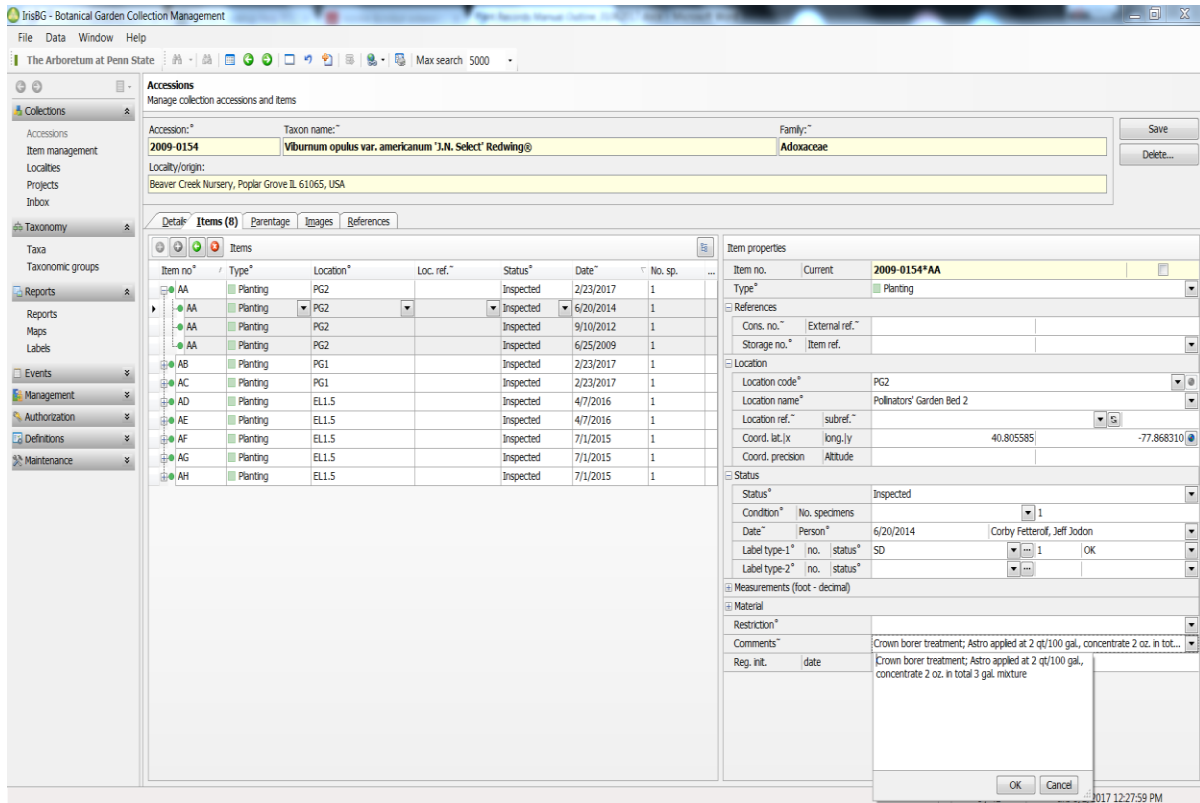


Figure 20: Chemical Application Information in Accessions Table

Not all chemical application forms are associated with an accession (i.e. chemical treatments on lawns or fields) and are therefore not recorded in IrisBG. These forms are still initialed and logged in the Chemical Storage and Applications binder for documentation.

For more information about integrated pest management practices, please see the Arboretum’s Landscape Maintenance Manual.

THE ARBORETUM AT PENN STATE

Plant Records:

Planting List

Compiled By:

Planted By:

Planted Date:

Invoice (Y/N)	Plant Name	Quantity	Condition (P,F,G,E)	Location Code	Comments	Display Label (Y/N)	Accession Tag(s) (Y/N)	Recorded in IrisBG	Mapped

Appendix B: Nomenclature Verification Process

Verifying Names of Straight Species

1. When verifying the name of a straight species (a plant that has not been cultivated), our standard sources for nomenclature verification are the Germplasm Resources Information Network (GRIN) and the Catalogue of Life. Search for the plant name here:

Germplasm Resources Information Network (GRIN)

<http://www.ars-grin.gov/cgi-bin/npgs/html/taxgenform.pl>

Catalogue of Life

<http://www.catalogueoflife.org/>

2. Consult with other sources that the name and author(s) is correct by using the above sources as the standard:

Tropicos

<http://www.tropicos.org/>

The Plant List

<http://www.theplantlist.org/>

The International Plant Names Index (IPNI)

<http://www.ipni.org/>

USDA Natural Resource Conservation Service

<http://plants.usda.gov/java/>

3. GRIN lists the native range for species that are not cultivated. Use this information to search sources that are authorities on plants of **specific ranges**:

Flora Europaea

<http://rbg-web2.rbge.org.uk/FE/fe.html>

Flora of China

<http://flora.huh.harvard.edu/china/mss/treatments.htm>

Flora of North America

<http://floranorthamerica.org/>

APC- Australian Plant Census

<https://www.anbg.gov.au/chah/apc/>

Lady Bird Johnson Wildflower Center- Native Plant Database (NPIN)

<http://www.wildflower.org/plants/>

The Pennsylvania Flora Project of Morris Arboretum

<http://www.paflora.org/>

The Plants of Pennsylvania- An Illustrated Manual

Rhoads, Ann Fowler; Block, Timothy A.

Scientific names for straight species should be verified using **at least four sources** listed in this process. If there is discrepancy between sources, additional references should be used to confirm the name. The complete library of references is available in IrisBG under *Management* → *Library*.

Verifying Names of Cultivated Plants

1. When verifying the name of a cultivated plant (a plant that contains a cultivar designation), first search the plant name in Google. This will give you an overall sense of information you will find when you begin verifying. It often produces helpful information to use as you search trusted sources.

Google Search

<http://www.google.com/>

2. The International Society for Horticultural Science (ISHS) has appointed International Cultivar Registration Authorities (ICRA) for plant groups (usually grouped by genus). Search the website to find the authority for the appropriate genus:

ISHS International Cultivar Registration Authorities (ICRA)

<http://www.ishs.org/sci/icra.htm>

Some common cultivar authorities are:

The International Clematis Register and Checklist 2002

Royal Horticultural Society

Official Registry and Checklist-Rosa

The American Rose Society

The American Hemerocallis Society

<http://www.daylilies.org/>

The Magnolia Society International
<http://www.magnoliasociety.org/CultivarChecklist>

The American Iris Society
<http://wiki.irises.org/bin/view/Main>

3. The Royal Horticultural Society (RHS) is a cultivar authority for many plant genera and a good source for verifying names of cultivated plants:

Royal Horticultural Society (RHS)
<http://apps.rhs.org.uk/horticulturaldatabase/>

4. Other sources for plants of specific genera or types are:

An Illustrated Guide to Maples
Le Hardy de Beaulieu, Antoine

Viburnums - Flowering Shrubs for Every Season
Dirr, Michael A.

Manual of Woody Landscape Plants - Their Identification, Ornamental Characteristics, Culture, Propagation, and Uses
Dirr, Michael A.

Herbaceous Perennial Plants- A Treatise on their Identification, Culture, and Garden Attributes
Armitage, Allan M.

Hydrangeas for American Gardens
Dirr, Michael A.

Royal Horticultural Society Encyclopedia of Conifers- A Comprehensive Guide to Cultivars and Species
Auders, Aris G.; Spicer, Derek P.

5. Other arboreta and botanic gardens are good sources for verifying cultivated plant names. Some common sources are:

Longwood Gardens
http://plantexplorer.longwoodgardens.org/ecmweb/ECM_Home.html

Missouri Botanic Gardens
<http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder.aspx>

Denver Botanic Gardens

http://navigate.botanicgardens.org/ecmweb/ECM_Home.html

The Morton Arboretum

<http://quercus.mortonarb.org/>

Chicago Botanic Garden

<http://www.chicagobotanic.org/>

6. The scientific name for all cultivated plants must be verified **using the process for names of straight species**. If the cultivated plant is a hybrid not found in nature, be sure to verify the correct genus and/or hybrid through the process of verifying the cultivar.

Names for cultivated plants should be verified using **at least five sources** listed in this process or the library in IrisBG.

Verifying Preferred Selling Names

1. If the cultivated plant has a preferred selling name (a name other than the cultivar used for selling a plant), a Google search will often provide the website for the **plant introducer or breeder**. This is often useful for finding pertinent information about the cultivar, patent number, preferred selling name, and trademarks.

Proven Winners

<https://www.provenwinners.com/>

Ball Horticultural Company

<http://www.ballhort.com/>

Syngenta Flowers- Goldsmith Seeds

<http://www.syngentaflowers.com/country/us/en/seeds/Pages/default.aspx>

2. Use information from Google and the plant introducers to search for a **patent and/or trademark** associated with the plant.

USPTO- United States Patent and Trademark Office

<http://www.uspto.gov/patents/process/search/index.jsp#>

3. Continue the process for verifying names of cultivated plants.

Selecting Common Names

1. GRIN is our standard source for common names (a name for a specific plant that often differs between regions), but occasionally does not list appropriate names for our region. Other sources for choosing and verifying common names suitable for our region are:

USDA Natural Resource Conservation Service

<http://plants.usda.gov/java/>

The Pennsylvania Flora Project of Morris Arboretum

<http://www.paflora.org/>

The Plants of Pennsylvania- An Illustrated Manual

Rhoads, Ann Fowler; Block, Timothy A.

Missouri Botanic Gardens

<http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder.aspx>

Longwood Gardens

http://plantexplorer.longwoodgardens.org/ecmweb/ECM_Home.html

Manual of Woody Landscape Plants - Their Identification, Ornamental Characteristics, Culture, Propagation, and Uses

Dirr, Michael A.

2. An important step in selecting a common name for a plant is to ensure that all plants of the same scientific name share the same common name and spelling, regardless of the cultivar. Search the *Taxa* table in IrisBG for other plants with the same scientific name before adding a new common name. For example:

Scientific Name	Common Name	
<i>Picea pungens</i> 'Fat Albert'	Colorado blue spruce	Incorrect
<i>Picea pungens</i> 'Mission Blue'	blue spruce	
Scientific Name	Common Name	
<i>Picea pungens</i> 'Fat Albert'	Colorado blue spruce	Correct
<i>Picea pungens</i> 'Mission Blue'	Colorado blue spruce	

THE ARBORETUM AT PENN STATE

Plant Records:

Accession Collection Form

Scientific Name				Project Name	
Country	State	County/District	Township	Local Place Name	
Latitude	Longitude	Slope (0-90°)	Aspect (N, S, E, W)	Elevation (feet)	
Origin: Wild Garden-wild Garden			Accession Number of Source Plant (if applicable)		
Habitat Description					
Material Type/Quantity: Seeds _____ Plants _____ Cuttings _____ Bulbs _____ Seedlings _____ Rhizomes _____ Other _____			Additional Notes		
Collected By			Collected Date		

Appendix D: How to Make Accession Tags

Create Tags in IrisBG

The accession tag template (EM1.doc) is saved as a custom template in IrisBG under Definitions→ Label types→ Embossed. IrisBG references this template when exporting tags from Item Management→ Create labels. For more information about creating custom templates, visit http://www.irisbg.com/p_screencasts.aspx.

1. Open IrisBG
2. Click on *Item Management*
3. Click on the *Create labels* tab
4. Use the yellow search fields at the top of the screen to pull the accession records for which you want to make tags
5. Select which accessions you want to create tags for by checking the boxes next to the accession number
6. Select *Embossed* from *Label type*
7. Click *View*- a Word document will open

Format Tags in Word

The accession tag format is also saved in the Datacard machine (Table 1). Before tags can be embossed, they needed to be formatted to meet the following standards:

- Characters do not exceed the maximum number per line (Table 1).
- There must be a total of 9 lines. Blank lines should be inserted to make 9 lines.
- Each blank line must contain at least one space entered with the space bar to be recognized as a blank line.
- There must be a caret before the first word in Line 1 and after the last word in Line 9. Datacard embosses all word between the carets.
- All words must be in ALL CAPS.

Margin	Line	Information	Max. Number of Characters	Line Position
200	1	Scientific Name	22	18.48
	2	Cultivar	22	16.48
	3	Trade Name	22	14.48
378	4		19	12.48
	5	Common Name	19	10.48
	6		19	8.48
200	7		22	6.48
	8		22	4.48
	9	Accession Number	22	2.48

Table 1: Accession Tag Format for Datacard Machine

1. Count the number of characters per line
 - a. Highlight the first line
 - b. Click on the *Review* tab
 - c. Click on *Word Count*
 - d. Confirm that *Characters (with spaces)* is within the appropriate number of maximum characters for that line (Table 1)
 - e. Click *OK*
 - f. Redistribute words to the next line if the character count is too large
 - g. Continue with all lines containing characters
2. Confirm that there are a total of 9 lines for each tag
3. Confirm that each blank line has at least one space entered with the space bar
4. Change ™ and ® symbols to (TM) and (R)
5. Confirm that there is a caret before the first word in Line 1 and after the last word in Line 9.
6. Confirm that all words are in ALL CAPS
7. Save the file as a Text (.txt) document

Emboss Tags

1. Turn on the Datacard machine
2. Load right hopper with the embossed side of the aluminum tags facing the front of the machine. (Not applicable to our tags. Either side can be embossed.)
3. Choose *Online* on the front screen of the machine- the machine should beep and read *Ready* on the screen
4. Open the text document in Notepad
5. Click on *File*
6. Click on *Page Setup*
7. Confirm all margins are set to 0
8. Confirm that the *Header* and *Footer* fields are blank
9. Click *OK*
10. Click *File*
11. Click *Print*
12. Select *Datacard* from the printer list
13. Click *Apply*
14. Click *OK*- the Datacard machine should start embossing tags

Trouble Shooting

Accession tag format disappeared or needs updated in Datacard:

1. Press F3 for *Setup*
2. Press F2 for *Supervisor*
3. Press F1F2 for Supervisor Code
4. Press F2 to view the menu
5. Press F1 to select *Emboss Line Location Table*
6. Press F1 to *Save Lpi= User Defined*
7. Press F1 to *Continue with Use Multiple Margins? Yes*
8. Press F3 to enter specifications from Table 1 for the appropriate lines

Input hopper is jammed during embossing:

1. Use key to open machine lid
2. Remove jammed tag from inside machine and recycle
3. Remove new tags from hopper and shuffle
4. Fill input hopper about halfway. Do not fill hopper to maximum capacity
5. Follow the directions on the Datacard screen to reprint the tag

Appendix E: Supplies and Services

Accession Tags

Machine	Datacard 295 Embosser Serial number: 18377	Mark Weaver- Service Manager Automated Card Systems, Inc. 106 Springfield Drive Canonsburg, PA 15317 724-820-1160 www.autocardsys.com
Tags	3.375" X 2.125" X 0.016" (CR80) ID Plate, 5005 black anodized aluminum with (2) 0.156" holes Product number: 31A50BK6215	Damon Company of Salem, Inc. 2117 Salem Industrial Drive PO Box 995 Salem, VA 24153 540-389-8609 www.DamonCo.com
Stakes	0.750" X 0.187" X 18" 6061 aluminum stake, angled pointed ends, (2) 0.160 holes offset from top by 1/8", black automotive finish	Marilyn Whittle Paragon Spring Company 4435-45 W. Rice Street Chicago, Illinois 60651 773-489-6300 www.paragonspring.com
Hardware	8-32 Nylon insert lock nut 18-8 stainless Part number: XNLN832 8-32 x 1/2 Phillips pan head machine screw 18-8 stainless Part number: XPMP83212	The Nutty Company, Inc. 19 Seemans Lane Milford, CT 06460 203-877-1709 https://www.nutty.com/
Wire	Solid single-conductor wire, UL 1007/1569, 20 AWG, 300 VAC, Black Product number: 8073K651	McMaster-Carr PO Box 94930 Cleveland, OH 44101-4930 330-995-5500 http://www.mcmaster.com/

Plant Display Labels and Commemorative Plaques

Machine	Gravograph M40DV Serial number: 78720-12	Nicole Hinds- Account Manager Account number: 188853 Gravotech
Software	Gravostyle 7.0.0.0 software	2200 Northmont Parkway Duluth, GA 30096
Label Material	Gravoglas® 2-Plex surface black/white, 3-ply Matte, 1/8" thick Product number: 29913N	1-800-843-7637 x 1762 http://www.gravograph.us/ http://www.gravostore.com/Home/
Filter Bags	5 pack filter bags for vac pump 46768/46769 Product number: 47568	
Cutters	11/64 GPLY/FLX carb cutter 030 Reference number: 42007030 Item number: 34017	
Stakes	3/4" X 3/16" aluminum, flat black powder coated with a pointed end, 3" leg at 45 degree angle	Marilyn Whittle Paragon Spring Company 4435-45 W. Rice Street Chicago, Illinois 60651 773-489-6300 www.paragonsspring.com
Tape	3M VHB Foam Tape- Adhesive on Both Sides, #4905, 3/4" X 72 yards X 0.020" Product number: 76665A68	McMaster-Carr PO Box 94930 Cleveland, OH 44101-4930 330-995-5500 http://www.mcmaster.com/
Bench screws	Round slotted, wood, solid brass, #6 X 5/8"- 5 pack Hillman Part Number: 490121	Lowes

Name Tags

Material	2 1/4" X 3 1/2", 1/16 Gravopoly 2-ply material with Arboretum and Penn State logos and rounded corners	Accent Signage 2322 Chestnut Avenue West Minneapolis, MN 55405 800-215-9437 http://www.accent signage.com/
Magnets	Magnet with adhesive backer, 0.5" X 1.75" Product number OSC-MGNT-05-175	Office Sign Company 310 NP Ave. N. Fargo, ND 58102 701-526-3835 http://www.officesigncompany.com/

Mapping

Equipment	Arrow 100 GPS Receiver and accessories	Fondriest Environmental 2091 Exchange Court Fairborn, OH 45324 937-426-2151 http://www.fondriest.com/
	RTK Service	KeyNet GPS 1670 East Race Street Allentown, PA 18109 800-833-9250 http://www.keynetgps.com/
Software	ESRI ArcGIS for Desktop Advanced	Mike Mrsa- Licensing Administrator Software at Penn State 0109 Technology Support Building University Park, PA 16802 psulss@psu.edu
	ESRI ArcGIS Online	James Spayd- Data Systems Coord. PASDA 0115 Land & Water Research University Park, PA 16802 814-865-8792 jfs126@psu.edu

Appendix F: How to Map Accessions

Collect Coordinate Points with GPS

1. Turn on the Arrow 100 GPS receiver in an area with a clear view of the sky
2. Turn on the iPad
3. Connect the iPad and Arrow via Bluetooth
 - a. Click on *Settings*→ *Bluetooth*
 - b. Switch to *On*- Arrow 100 should be listed in *My Devices* as connected
4. Open the EOS Tools Pro app
5. Turn on the RTK service
 - a. Open the *Differential* tab on the bottom of the screen
 - b. Click *Start*
6. Set conditions for collecting
 - a. Open the *Alarm* tab on the bottom of the app
 - b. Select *Sub-foot* from the *Defaults* list
7. Open the *Status* tab
8. Wait 5 minutes for GPS to configure and RTK service to connect- do not move the GPS
9. Open the Collector app
10. Set the Location Profile
 - a. Open *Settings*→ *Location Profile*
 - b. Select GCS NAD 83 2011
 - c. Go back to Settings
 - d. Select *Done*
11. Open the Plant Accessions NAD83_11 map
12. Position the GPS receiver in the middle of the plant or group of plants
13. Zoom in on the GPS location on Collector
14. Swipe left to open the *Collect a new feature* bar on the right hand side of the screen
15. Select the feature layer for the garden where the accession is located
16. Enter the four digit accession year in Acc Year
17. Enter the four digit accession number in Acc No
18. Enter the two letter item number (qualifier) in all caps
19. Enter any comments
20. Click *Submit* in the upper right-hand corner

For more information about how to use the Arrow 100, refer to the Arrow Series User's Manual in the Horticulture/Plant Records office or visit <http://www.eos-gnss.com/>. For more

information about how to use ESRI's Collector application, visit <http://doc.arcgis.com/en/collector/>.

Export Points from ArcGIS Online

1. Sign in to Penn State Data Commons-
<http://datacommons.maps.arcgis.com/home/index.html>
2. Open *My Content*
3. Hover over the down arrow next to *Plant Accessions NAD83_11*
4. Select *Open in ArcGIS for Desktop*
5. Double click on the download in the bottom left hand corner- the map will open in ArcGIS for Desktop
6. Right click on the feature layer for the garden you want to export in the *Table of Contents*
7. Select *Data* → *Export Data*
8. Save the exported feature layer in GIS Mapping Projects → Accession Mapping folder
9. Rename the feature layer:
 - a. Location code_Completed_Accessions_NAD83_11_ MonthDayYear
10. Click *Save*
11. Click *OK*
12. Select *No* when asked: *Do you want to add the exported data to the map as a layer?*
13. Close the downloaded map- do not save
14. Open Documents → GIS Mapping Projects → Accession Mapping folder → Edited
Accession_NAD83_11.mxd
15. Click *Add Data* on the upper toolbar
16. Select the newly exported layer
17. Click *Add*- the layer will appear in the *Table of Contents* on the left hand side

Review Points in ArcGIS for Desktop

1. Right click on the feature layer in the *Table of Contents*
2. Select *Open Attribute Table*
3. Address any comments made during mapping
 - a. Click on *Editor* on the upper tool bar
 - b. Select *Start Editing*
 - c. Delete comments once problems have been resolved
 - d. Click on *Editor* → *Save Edits*
4. Review accession fields for completeness

- a. Confirm *Acc Year* field is four digits
- b. Confirm *Acc No* field is four digits
- c. Confirm *Item No* field is two capital letters
- d. Click on *Editor* → *Save Edits* → *Stop Editing*

Import Points into IrisBG

1. Calculate X,Y points in ArcGIS
 - a. Right click on the feature layer in the *Table of Contents*
 - b. Select *Open Attribute Table*
 - c. Open *Table Options*
 - d. Select *Add Field*
 - e. Name the new field *ItemCoordX*
 - f. Change type to *Double*
 - g. Click on *Editor* on the upper tool bar
 - h. Select *Start Editing*
 - i. Open the attribute table and right click on one of the new fields
 - j. Click *Calculate Geometry*
 - k. The coordinate system selection is not applicable because the data source and data frame are the same
 - l. Units should be *Decimal Degrees*
 - m. Click *OK*
 - n. Repeat with another new column named *ItemCoordY*
2. Add decimal points to X,Y coordinates
 - a. Right click on *ItemCoordX*
 - b. Select *Properties*
 - c. Select *Numeric* and change the number of decimal places to 8
 - d. Click *OK*
 - e. Click *Apply*
 - f. Click *OK*
 - g. Repeat with *ItemCoordY*
3. Copy the Attribute Table to an Excel document
 - a. Open *Table Options*
 - b. Click on *Select All*
 - c. Right click on the first row in the table
 - d. Select *Copy Selected*
 - e. Paste into an Excel document
 - f. Save the document in IrisBG → *Data Imports* → *Coordinate Point Data Imports*

- g. Name the file:
 - i. Location Code_Coordinate Points Import_MonthDayYear
 - h. Delete unnecessary fields
 - i. Expand the *ItemCoordX* and *ItemCoordY* columns to show all decimal places
 - j. Check random X,Y points with corresponding points in ArcGIS- X,Y points should be exactly the same as recorded in ArcGIS
 - k. Select accession numbers that have the year “0000” and paste on a separate tab- the import data module in IrisBG will not accept “0000”
 - l. Insert a new first column and title it *Action*
 - m. Copy the letter “U” for update into all rows
 - n. Save the document
4. Import coordinate points into IrisBG
 - a. Open IrisBG
 - b. Click on *Maintenance*
 - c. Click on *Import Data*
 - d. Click on the file folder at the top of the page
 - e. Select the Excel document
 - f. Click *Open*
 - g. Click *OK* to confirm import- *The data is ready for import* should appear at the bottom of the screen
 - h. Click *Accept* to import data
5. Manually enter coordinate points for accessions with the year “0000”
 - a. Click on *Accessions*
 - b. Enter the accession number in the yellow search field at the top of the screen
 - c. Click on the *Items* tab
 - d. Copy and paste the coordinate points from Excel

Appendix G: Plant Disease Clinic Report Example

PENN STATE



College of
Agricultural Sciences

Cooperative Extension
Department of Plant Pathology

(814) 865-3761
FAX (814) 863-7217

The Pennsylvania State University
210 Buckhout Lab
University Park, PA 16802

15-872

CURB
7/28/15

PLANT DISEASE CLINIC

SPECIMEN: # 15-872
PLANT: Sumac 'Low Grow'
COUNTY: Campus
July 28, 2015

Ted Zeljak
PSU Arboretum
University Park PA 16802

Culture tests on the sumac sample showed the presence of *Botryosphaeria* no *Verticillium* or other pathogens were isolated. *Botryosphaeria* commonly is associated with branch dieback on many woody ornamentals. Dead branches can be pruned out while the bark of the plant is dry, but there is no completely effective control in some cases. Plants weakened by various factors including poor subsurface drainage, drought stress, mechanical injury, root rot diseases, winter injury, etc., are susceptible to invasion by this and other canker-causing fungi.

Sara R. May

Sara R. May, Coordinator
Plant Disease Clinic
814-865-2204

Appendix H: Chemical Application Form Example

ARB
6/6/16

Daily Landscape Pesticide/Fertilizer Application Record

PSU – Office of Physical Plant - Nittany Landscape Depot
Business License – BU 7798

Applicator Name: David Waltz Date: 6/1/16
 Applicator ID Number: 501684 Weather, Temp: Sunny, warm
 Start Time: 6:30 AM Stop Time: 8:00 AM
 Crop Treated: Turf/Trees&Shrubs/Shrub Beds/Annuals/Weeds Species: Thisle

Location

Area Arboretum Specific Location(s) Marsh meadow
 Size of Treated Area: All

Pesticide Used

Brand Name: Lontrel Active Ingredient: monoethanolamine salt, Clopyralid, dichloro,
 Formulation: Liq. Conc EPA Reg. #: 62719-305
(liquid conc., dry conc., granule, WP, etc)
 Rate: 0.5oz/1gal. Total Amt. Of Chemical Used: 30z.

Fertilizer Used

Brand Name or Type: _____ N-P-K: _____
 Rate: _____ Total Amt. Used: _____

**** MAKE SURE EQUIP IS CLEANED AFTER USE ****

INFO

Round Up	glyphosphate	524-529
Snapshot	trifluralin + isoxaben	62719-175
Dimension	dithiopyr	10404-86
Manicure	tetrachloroisophthalonitrile	50534-202-10182
Dylox	trichlorfon	432-1308
Tupersan	siduron	10163-213-2217
Battleship	MCPA + triclopyr	228453-5905
Round Up ProMax	glyphosphate	524-579
Round Up QuikPro	glyphosphate	525-535
Specticle Total	indaziflam+Diquat+Glyphosate	432-1532
Lesexo Prosecutor	glyphosate	524-536