

Center for Applied Plant Sciences Plant Growth Facility Standard Operating Procedures

May 2014



THE OHIO STATE UNIVERSITY



BSF SOP

Table of Contents

Facility Description	3
Biotechnology Support Facility Floor Plan	4
Facility Purpose, Mission, Staff and Oversight	5
Safety and Security	6
Space Allocation	7
Services, Supplies, Tools	8
Sanitation and Recycling	9
Pest Management	10
Record Keeping	12
Best Practices	13
Violations	15
Appendix A. Maintenance	16

Facility Description, Purpose, Mission and Staff

Introduction

The Center for Applied Plant Sciences (CAPS) Plant Growth Facility is comprised of the Biotechnology Support Facility (BSF) and the Rightmire Growth Chamber. Completed in 1993, The Biotechnology Support Facility houses support facilities for plant science research. The facility has approximately 7,000 square feet of research greenhouse space under glass, nine growth chambers, six of which are walk-ins and a preparation room in addition to storage rooms for soils, supplies, seeds, and chemicals. There is a cold room for seed storage and vernalization. The Rightmire Growth Chamber room, located in adjacent Rightmire Hall room 005, houses six additional growth chambers belonging to CAPS with another five growth chamber units under management of the Arabidopsis Biological Resource Center (ABRC). The Plant Growth Facility serves faculty, students and staff of the Center for Applied Plant Sciences.

Facility Description

The BSF greenhouse facility is a glass and aluminum structure built in 1993 by National Greenhouse. The facility covers 7,000 sq. ft. under glass divided into 10 independently controlled rooms. A Priva environmental control system manages environmental conditions and collects environmental data. There are three room sizes: four large 24' X 46', two medium 24' X 23', four small 24' X 11'. Each space has the following equipment.

- Medium and large rooms have rolling aisle benching. Small rooms have fixed aisle benches.
- Hot and cold domestic water and a centralized fertigation system.
- Height adjustable HID lighting, minimum 400w metal halides and high pressure sodium.
- Hot water perimeter heat.
- Evaporative cooling.
- Automated shade/heat retention system
- Fan tube air circulation
- Sensor unit for control and environmental data collection.
- Some rooms have automated irrigation.

In addition to one office, the headhouse has a corn storage room, a cold room, a pesticide storage room and a potting room/prep area. There are also two rooms for bulk material storage, one for soils and one for supplies. There is a workshop providing space for mechanical, electrical and plumbing supplies and work space. There are ten -80 DNA and two -21 seed storage freezers housed at the facility in the corridors.

Room 156 contains six Conviron GR128 walk-in growth chambers, room 160 contains two Conviron PGW36 growth chambers and room 160B contains one GR48 walk-in growth chamber for a total of 936 sf of growth space.

Rightmire Hall room 005 houses five Conviron PGW36 chambers and one Conviron E15 chamber totaling 2331 sf of growth space at current configuration. Also housed in this room are four Biochambers and one Percival chamber owned by ABRC, three plate chambers and an additional three growth chambers which are not presently functional.

Figure A. is a floorplan of the BSF.

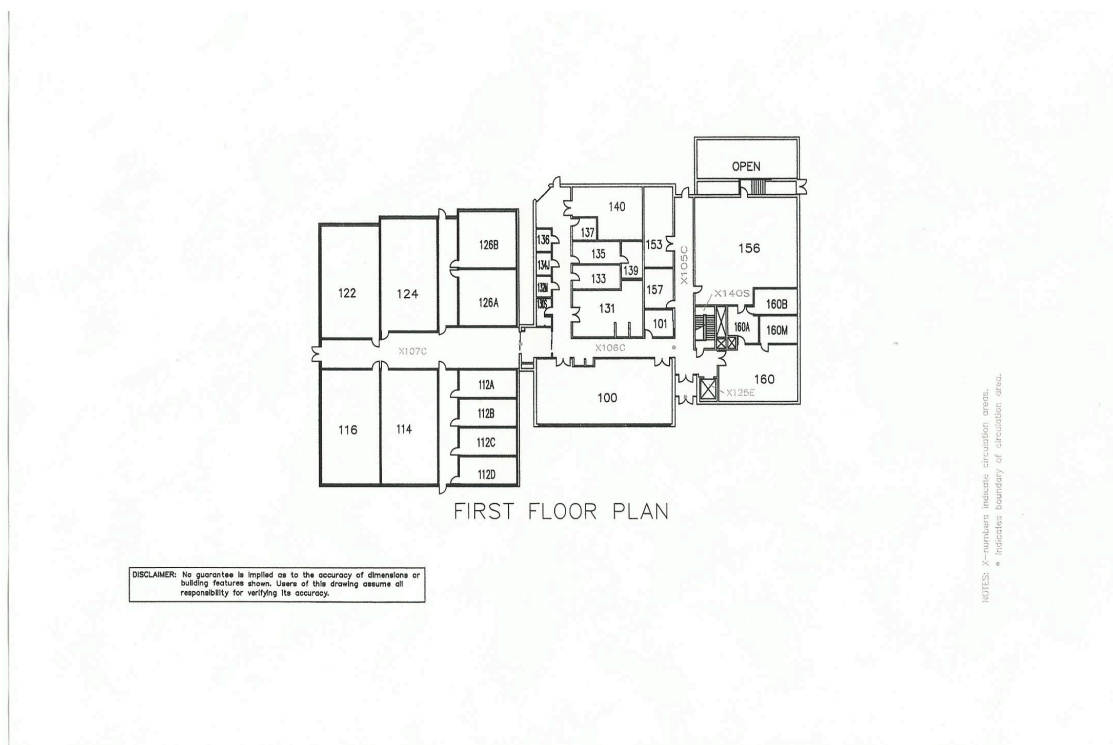


Figure A. Floor plan of the Biotechnology Support Facility

Legend for Figure A.

Room Number	Purpose
100	Pot washing, pot filling, lab supply storage
101	Greenhouse Superintendent's office
112A-D	Greenhouse rooms 24'X11'
114, 116, 122, 124	Greenhouse rooms 24'X44'
126A-B	Greenhouse rooms 24'X26'
130?	Electrical panel room
131	Soil and bulk material storage
132	Restroom
133	Cold Storage room
134J	Janitor Closet
135/139	Pesticide Storage
136	Storage
137	Storage/roof access
140	Storage
153	Work Shop
156	Growth Chambers 1-6
157	Storage
160	Growth Chambers 8 & 9
160A	Common Work Space
160B	Growth Chamber 7
160M	Maintenance Closet
X105C	Freezer Corridor

Purpose

The CAPS Plant Growth Facility supports the research, teaching and outreach missions of CAPS by maintaining a variety of controlled environments used for plant growth.

We provide numerous opportunities for the community to get more familiar with plant biotechnology and current research at the facility. Staff provides facility tours and works with outreach programs such as Breakfast of Science Champions.

Mission

It is the goal of the CAPS Plant Growth Facility to optimally maintain the facility's controlled environments and provide services facilitating the explorations of researchers in CAPS.

Facility Staff

The CAPS Plant Growth Facility has one full-time support staff member. An additional staff member is employed at 15% time to oversee operations and for project management. The titles and primary responsibilities of staff are as follows:

Greenhouse Superintendent (100%) handles day-to-day operations, allocates space, conducts outreach activities, handles facility preventative maintenance, and is responsible for new user orientation training.

Program Manager (%15) oversees facility operations, manages website, and coordinates project management.

Contact Information

Greenhouse Superintendent

Office: 101 BSF

Phone: (614) 292-9241

Program Manager

Office: 704 Bio Sci Greenhouse

Phone: (614) 292-7904

Additional Information is located on the facility website at: <https://caps.osu.edu/biotech-support-facility>

Oversight

An advisory committee composed of the above staff plus one faculty member representative from CAPS, the ABRC Associate Director, and one postdoc representative from CAPS will act in an advisory capacity to set protocols, approve usage, and facilitate other decisions as required.

Safety and Security

Hours of Operation

The core staffing hours are 9AM-2PM Monday-Friday.

Keys/Keycard Access

The BSF and Rightmire Hall are secure access buildings requiring keys to be issued or keycards to be activated by CAPS administration.

Persons requiring access to the plant growth spaces must first complete an orientation and training session with the Greenhouse Superintendent before access will be granted. Under no circumstance is access permitted using the credentials of someone other than to the person keys/keycard access was granted. Persons who have not been granted access must be accompanied at all times by a person who has been granted access. It is the responsibility of this person to ensure all protocols are followed by the non-credentialed companion. Lost or stolen keys/keycards must be reported to the CAPS office and to campus police if applicable.

Building Security

Persons working at the facility are required to ensure the doors at all entrances/exits securely fastened as they enter/exit. Blocking open of doors is prohibited. If an unknown person slips in while an entrance/ exit is open, please do not hesitate to ask for their affiliation.

Emergency Procedures

Instructions for handling various emergency situations are outlined in the Building Emergency Action Plan on file with the BSF Building Coordinator. The Greenhouse Superintendent acts as the Building Emergency Coordinator and the Evacuation Coordinator.

Personal Protective Equipment (PPE)

Due to the nature of the research performed in the CAPS Plant Growth Facility, PPE is required in plant growth spaces. Dedicated lab coats are required for each plant growth space. Gloves may or may not be required. Signs are posted to remind users of the PPE required for each the spaces. Please check signs at each visit to be sure proper PPE is being used for the space.

Required Researcher Training

Prior to working at the facility, all faculty, staff and students using the CAPS Plant Growth Facility are required to take the following training. Facility access and access to the reservation system will not be granted until training is completed. Working at the facility without completing training is considered a major infraction of protocol.

- Read and understand the Standard Operating Procedure (SOP) document
- Watch the Best Practices Power Point on the facility website
- Meet with the Greenhouse Superintendent for a facility tour
- Take the WPS training on Carmen

Worker Protection Standard Training

In accordance with EPA guidelines, all students, faculty and staff using the CAPS Plant Growth Facility must be trained in pesticide safety. The EPA instituted the Worker Protection Standard (WPS) and has outlined a training program for persons who perform hand labor tasks involved in the production and harvest of plant materials. This training must be completed before the person accumulates more than 5 separate days working in treated areas. At the CAPS Plant Growth Facility, users are required to complete the training program prior to their project start date.

To facilitate training, greenhouse workers and users can fulfill this requirement via a web training program offered through Carmen. Please arrange a visit to the greenhouse facility to familiarize yourself with the location of PPE, MSDSs, and application log information prior to taking the online training. If you any questions about the training or protocols for the facility, please contact facility staff.

Space Allocation

Allocation

Greenhouse and chamber space is allocated on a first come, first serve basis with priority to CAPS members. No space is permanently assigned. All space is common shared space. Some spaces are allocated for specific crops as the equipment within the area is specifically suited for certain crops. Requests for space requiring specialized conditions must be submitted to the Greenhouse Superintendent in advance with sufficient time for arrangements to be made. Typically, six to eight weeks of notice is sufficient. Space requests from non-university entities require approval from the Advisory Committee and will be subject to university overhead costs in addition to any costs to CAPS associated with the request.

Space Request Procedure

Researchers must submit requests using the online space request system. A tutorial on how to use the system will be covered during the new user orientation session. All users must undergo Worker Protection Standard Training as required by the US EPA, before the start of their project. Training is available online via CARMEN.

Violations

Users who violate facility protocols may be denied space.

Facility Services

The facility staff provides and/or coordinates the following services:

- Project consultation and troubleshooting
- Pest and disease diagnostics and control measures
- Environmental control programming and data retrieval
- Sanitation including proper GMO disposal
- Facility and equipment maintenance
- Facility space assignments and scheduling
- Outreach programs

Supplies

Researchers are required to supply all materials necessary for their research and store them neatly in allotted storage space. Materials stored in the plant growth areas should be secured in water/weatherproof containers. Staff cannot be responsible for supplies damaged by temperature, water, light, or other accidental breakage. Staff will assist in receiving and stowage of bulk materials. Researchers are responsible for keeping their storage space orderly and to promptly clean pots, flats and other items in order to reduce transmission of pests and diseases. Please do not store dirty items on shelving with clean items.

Tools

Researchers are required to supply all tools necessary for their research and to store them clean and neatly in allotted storage space. Staff is not responsible for lost or stolen tools so it is recommended that high dollar items be secured in the researcher's lab space. Users are responsible for ensuring that all common tools (ie. media scoops) are clean when they have finished using them.

Carts

There are a number of carts available for daily use. Researchers needing carts for extended use should purchase their own for exclusive use. Carts should be returned by the end of the day to the prep room clean and in good working order.

Sanitation and Recycling

Sanitation is key for effective management of pest and disease issues. Following university initiatives to reduce waste on campus, there are several techniques employed at the facility to divert waste from general trash.

Sanitation Practices

While the greenhouse staff does perform regular cleaning services in greenhouse rooms and the prep room, greenhouses users should clean up their own messes and not leave for one of our staff to find. There are dust pans and brooms available in the soil prep room (room 100) in addition to a shop vac and mop located in room 156.

Hoses should be laid neatly on the floor and hose breakers must be hung over the faucet off of the ground. This is important in keeping the hose end from exposure to disease microbes on the floor.

Recycling

All plastic bottles, paper, cardboard, glass bottles, and metal cans and foil can be put into red recycling bins found in the potting room, office and in the hallway. Other items such as ink cartridges and cell phones, electronics and non-standard metals can be disposed of through the CAPS office and various campus venues by contacting Energy Services and Sustainability Office.

Trash

All other refuse may be disposed of in regular trash cans. No plants or soils may be discarded in regular trash even if they are wild types. It is facility policy to handle all plants and soils as transgenic waste. Non-transgenic plants and associated soils intertwined with non-plant/soil materials may be discarded in minimal amounts in regular trash. Absolutely no transgenic waste is permitted in regular trash.

Handling Transgenic Waste

Genetically modified materials require special handling by the facility prior to disposal. Researchers should dispose of plants and soils of transgenics in the yellow carts located in the back hallway by room 140BSF. No pots, labels, stakes, or any other plastics should be discarded here. The transgenics will be steam sterilized by facility staff then sent to the compost facility. In cases where the PI has specifically stated in their agreement with a regulatory agency that transgenics will be autoclaved, the PI is responsible for carrying out disposal per the agreement.

Pest Management

The greenhouse uses an integrated pest management approach to dealing with pest and disease issues. We rely primarily on biological controls and will use chemical controls as a last resort. Facility staff will work with individual researchers to create a pest control plan, if so desired.

Start Clean

Projects should start clean by using clean sanitized pots, sterile media and disease and pest-free plant material. It is also recommended that users make sure tools and any other materials are clean and disinfected prior to and after each use to prevent the spread of pests and disease.

Introducing Plant Materials

Users bringing in plant materials to the facility, whether from the field, from another greenhouse facility or from a store, must have it inspected by facility staff prior to placing in the greenhouse. This allows staff to identify and address pest problems before they have an opportunity to establish.

Stay Clean

Users are asked to help keep growing areas clean of debris. Please dispose of unnecessary, diseased, pest-ridden, and dead plants promptly. Please clean up spills and messes. Keep hose breakers off of the floor.

Weekly Monitoring/Scouting

Facility staff monitors yellow sticky cards on a weekly basis. Reports generated from the counts as well as information gathered from visual inspections and reports from researchers are used to make pest control decisions and develop an order of entry to plant growth spaces.

Order of Entry

In order to reduce the transmission of pests and diseases, an order of entry will be updated weekly based on scouting reports. The order will list plant growth spaces from cleanest to most infected and posted on the dry erase boards in the BSF and Rightmire 005. Researchers should note these daily as they go about their work to make sure they are following the correct order of entry. Users who have entered a space lower on the list cannot enter or re-enter a space above it on the list until the next day. **Dedicated lab coats are required by all users for each growth space.**

Releases of Beneficial Insects/Arthropods

Based on scouting reports, the type and quantity of beneficial organisms to be released is determined and implemented by facility staff. This is usually done bi-weekly or at minimum monthly to maintain populations of beneficials at effective levels.

Watering

Improper watering is often the culprit initiating pest and disease issues. Users should evaluate their watering practices and adjust according to environmental conditions to avoid plant stress. Please refer to the topic of Watering under the Best Practices entry.

Chamber Rotations

Rotations have proven critical to breaking pest lifecycles. By enforcing a chamber clean out every 3 months, BSF staff can more effectively control and isolate pest and disease issues. Refer to the graphic in Figure 2. for a diagram outlining the rotation process.

- There will no longer be any continuous cycling in chambers—all chambers will enter the rotation cycle. Growth spaces will have a 6-week window for planting. This window may close sooner than 6 weeks IF space is full or INSV is detected or other problems arise.
- It is the researcher's responsibility to check for available space BEFORE planning to plant.
- Chambers will have posted on the door the last date for new plants. Absolutely no new plants will be allowed in the space after the end date —even if there is space available.
- No plants are permitted to move from one space to another. Once placed in a chamber or greenhouse, they are to stay in that space.

- Chambers will have posted on the door the target harvest date. All plants should be removed by this date. If researchers are unable to meet this deadline, they must contact the Greenhouse Superintendent to make arrangements.
- Once a space is empty, it will be cleaned by facility staff and heat treated for 4 days, then reopened for planting.

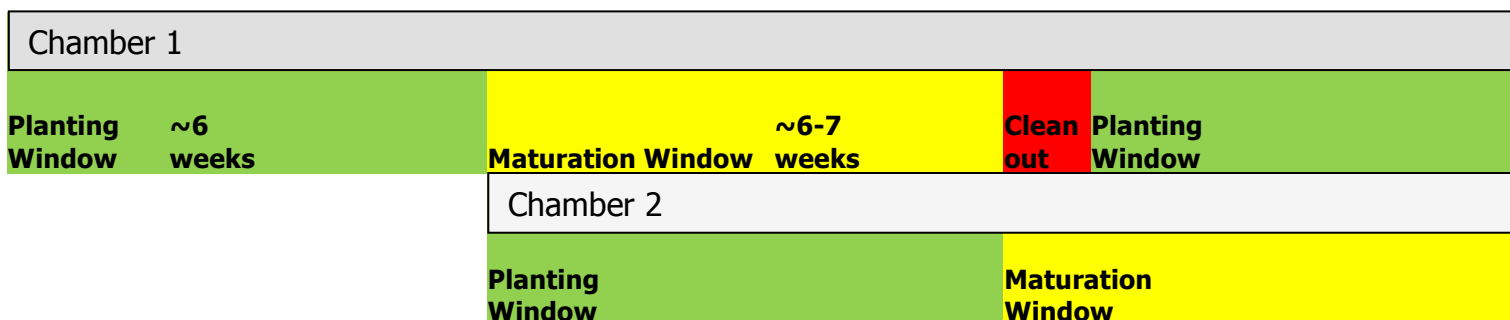


Figure 2. Graphic outlining sample chamber rotation.

Chemical Pest Control

When warranted, chemical pesticides will be employed for pest control. Whenever possible, we prefer to use chemicals with low human and environmental toxicity such as oils and soaps. Chemical controls work best when pest populations are low so attention to potential pest problems is critical. Chemicals will be selected based on target pest, REI and project parameters usually in consultation with the plant's owner. Pesticides can only be applied by facility staff and those holding a current Ohio Pesticide Applicator's license. All pesticide applications must be recorded on the Pesticide Application log per ODA and EPA regulations. Applicators must follow all PPE requirements. Areas where applications have been made must be posted with required information and REI.

Record Keeping

Pesticide Application Log

As required by the EPA and the Ohio Department of Agriculture, all pesticide applications made at the facility must be entered into the Pesticide Application Log posted on the bulletin board by room 101 BSF. A valid pesticide applicators license issued by the Ohio Department of Agriculture or proof of pesticide handler training is working under the license of another is required for pesticide applicators.

WPS Training

The facility staff will keep a record of all participants in the WPS and pesticide handler training, if applicable, whether via the online course or in group training sessions. Users who do not attend training or whose training has expired will not be permitted to use the facility and will not be issued keys/keycard access. Facility staff will send reminders to users who require retraining after the five year expiration.

Maintenance Records

The facility staff shall keep detailed records on facility maintenance they perform or that is hired out. A calendar with monthly preventative maintenance tasks can be found in Appendix A. as a guide for performing maintenance at regular intervals. This will assist in diagnosing equipment repairs in addition to permit budget planning for maintenance.

Equipment Specifications

The facility staff shall keep records of facility equipment, parts numbers, and sources to enable time-sensitive sourcing of parts for repairs. Whenever possible it is recommended that spare parts for common equipment be on hand for emergency repairs.

Best Practices

Watering Practices

Proper watering is the most important factor in healthy plants and project success. As such, it deserves a good deal of attention and effort on the part of the researcher to properly train staff and students and on the part of staff and students to be diligent in the course of their watering. Researchers often relegate this task to new, inexperienced students or staff while providing little or no instruction. The guidelines below are an initial framework for the training or retraining of staff and students. Please review the points below with all students and staff prior to bestowing the responsibility of watering upon them.

- Overwatering is the number 1 cause of plant diseases, pest problems and plant death! Overwatering can be too much water at once (quantity) and/or watering too often (frequency).
- Overwatering weakens and can kill roots (lack of oxygen) and allows pests and diseases an opportunity.

Quantity- How much water is needed?

The quantity depends on the size of the pot and the degree of moisture in the potting mix. Some potting mixes retain moisture longer than others. It will take time and experience to learn how much or little moisture your selected potting mix retains. After watering, the soil should be completely saturated with no dry pockets.

- Never leave plants in a tray of standing water for longer than 30 minutes. Most potting mixes will reach saturation within 10 minutes—excess water in trays after this will only deteriorate the roots and weaken the plants. Soils that are already saturated, will not take up any additional water.
- Green algae growing on soil surface is sure indication of overwatering.
- Plants found standing in trays of water will have holes poked into the trays!
- Arabidopsis IS NOT AQUATIC!
- Watch nested flats: water can get “trapped” between the flats and provide a breeding ground for pests and pathogens.

Frequency- How often to water?

Some labs have a precise watering schedule they follow and watering occurs not based on whether the plant needs water but on the day the schedule says to water. Unfortunately, plants can't read the schedule to know they are to be in need of water only on the given watering days. Researchers should plan to check on their plants daily and water as needed.

Know if plants need water—what is dry?

There are several ways to check the moisture level of the potting mix. One method is by color of the potting mix. Most mixes are a lighter brown color when dry and darker when wet. Another method is by weight. Potting mixes that are saturated with water are heavier than dry mix. Experienced waterers can lift a pot and tell by the weight if water is needed. A third method is touch. Feeling the potting mix is likely the easiest method for determining saturation. Also observe the plant for signs of wilt (may be due to under or overwatering) and general coloration. Combining all of the methods above, a waterer can make an educated decision about the need for water. Below are additional guidelines for watering:

- Only water the pots/cells that are dry instead of whole flat. Each plant is an individual and may grow at a slightly different pace than others in the same flat. Take time and attention to assess and address the watering needs of each individual plant.
- If bottom watering whole flat, add only enough water to cover bottom of flat. This should get taken up within a few minutes. If not, then plants were not thirsty. Pour off excess water after 10 minutes!
- Never leave plants standing in water longer than 30 minutes. Water not used in 30 minutes will deprive roots of oxygen and root rotting pathogens will set in.

Sanitary Practices

Following sanitary practices in the plant growth areas is just as important as following them in the labs. The guidelines below are highly recommended but not required:

- DO use clean and sterile pots and trays and sterile potting mix.
- DO surface sterilize seed (10% bleach, 10 min.)
- DO report infestations of pests and diseases to Greenhouse Superintendent
- DO know how to identify pests such as thrips, fungus gnats and signs of INSV

The following sanitary practices are required of all researchers:

- **No seeds are permitted in the potting area, room 100 BSF, to prevent contamination of media**
- DO wear dedicated lab coat for each growing space
- DO promptly dispose of unnecessary plants in yellow steam carts (no plastics, no stakes, etc)
- DO keep growing spaces and adjacent areas, and potting room 100 clear of debris/dirty pots/dead plants
- DO follow order of entry to chambers/growth rooms/greenhouse
- DO water and fertilize properly (use care not to overwater)
- DO cover all plants during transport and disposal

- DON'T leave chamber/rooms doors hanging open
- DON'T move plants from one chamber/room to another

Planting Procedure

- Use the online request system to reserve space for your plants
- Fill pots in 100 BSF then plant seeds in room 160A, the greenhouse or your lab
- For Arabidopsis, 3 scoops of media = 1 flat. Incorporate 2 TBL of Osmocote for each flat prepared.
- It is required that all pots/flats be labeled with researcher name and PI. Unlabeled plants will be considered abandoned and will be disposed of without notice.

Protocols for INSV infested plants

Since INSV can devastate a research project in short order, we have in place a prepared plan of action should INSV be detected. If researchers suspect INSV in their plants or in the plants of another researcher, they must immediately report this to the Greenhouse Superintendent so testing can be conducted. Immediate action is required to contain infection.

- If INSV is confirmed, the researcher must immediately discard all INSV infected plants or if possible, arrange for isolation space that will not affect other plants or projects. The isolation area will be at the discretion of the Greenhouse Superintendent.
- No new plants will be permitted in an infected space.
- Any plants to be removed from an infected space must be bagged before removal.
- INSV infected plants must be autoclaved prior to disposal and not discarded in the yellow carts.
- Anyone working in an INSV infected space is to immediately exit CAPS buildings when work is completed- they may return the next day after they have showered and changed clothing.

General

- No personal plants are permitted in the facility.
- The OSU campus is a smoke-free environment. No smoking is permitted in or around the buildings. It is especially important that users who do smoke wear gloves when handling plant materials as transmission of pathogens from cigarette and cigars to research plants is possible.
- Stagger germination dates and location of valuable plants to increase chances of success. The aging mechanical systems of current chambers leaves them prone to breakdowns, which may cause crop loss. It is recommended that researchers devise a planting scheme that provides redundancy to ensure project success.
- It is the responsibility of the PI to ensure that all lab staff are educated in these standard operating procedures and understand the ramifications of violation of protocols.

Violations

As a member of CAPS, it is expected that all CAPS Plant Growth Facility users will wholly comply with the protocols and procedures as set forth in this SOP and in the orientation and training. If for some reason compliance is not possible, a written letter of the circumstances preventing compliance must be submitted to the CAPS Plant Growth Facility Advisory Committee prior to non-compliance. It is expected that all users will additionally comply with the regulations of The Ohio State University and other regulatory agencies such as the Ohio Department of Agriculture, the EPA and the USDA. Violations which endanger the health or safety of facility users, will be dealt with swiftly and with severe repercussions.

Reporting of Violations

Violations of the CAPS Plant Growth Facility SOP will be addressed by the Greenhouse Superintendent. When warranted, the CAPS Plant Growth Facility Advisory Committee and the CAPS Director will become involved. Violations can be reported to the Greenhouse Superintendent for investigation. For recordkeeping purposes, it is requested that reports be made in writing using the online submission form or by downloading a printable form from the CAPS Plant Growth Facility website and placing in to the Greenhouse Superintendent's mail box.

Minor Infractions

Infractions considered minor are those which do not pose a significant threat to persons working at the facility or jeopardize the work of other research projects. This would include overwatering, failure to maintain orderly supplies, failure to clean personal lab tools, failure to return common tools.

Penalties for non-compliance will be as follows:

- 1st violation: Documented written warning with violation report sent to PI.
- 2nd violation: Documented written warning with violation report sent to PI.
Mandatory conference with Greenhouse Superintendent to review Best Practices.
- 3rd violation: Documented written warning with violation report sent to PI.
Mandatory meeting with Greenhouse Superintendent, CAPS Program Manager and PI.
- 4th violation: Documented written warning with violation report sent to PI and CAPS Director.
Mandatory meeting with PI and CAPS Plant Growth Facility Advisory Committee to determine course of disciplinary action.

Major Infractions

Infractions considered major are those which pose a significant threat to persons working at the facility and/or jeopardize the work of other research projects. This would include bringing seeds into 100 BSF, moving plants among chambers, failure to properly label chemicals, failure to wear PPE as required and failure to obtain training.

Penalties for non-compliance will be as follows:

- 1st violation: Documented written warning with violation report sent to PI.
Mandatory conference with Greenhouse Superintendent and PI to review Best Practices.
- 2nd violation: Documented written warning with violation report sent to PI.
Mandatory meeting with PI and CAPS Plant Growth Facility Advisory Committee to determine course of disciplinary action.
- 3rd violation: Documented written warning with violation report sent to PI and CAPS Director.
Mandatory meeting with PI and CAPS Director to determine course of disciplinary action.

Appendix A. Maintenance Calendars Greenhouse Maintenance Calendar

January

- Check HID bulbs and replace as needed
- Clean cooling pads 112-116

February

- Clean cooling pads 122-126
- Change fan belts on exhaust fans (every other year)

March

- Check HID bulbs and replace as needed
- Clean sump tanks

April

- Check fan jet tubes and replace if needed
- Calibrate sensors

May

- Check HID bulbs and replace as needed
- Inspect and lubricate shutter arms

June

- Clean sump tanks
- Clean screens on roof vents

July

- Check HID bulbs and replace as needed

August

- Check HAF fans

September

- Check HID bulbs and replace as needed
- Check heat valves

October

- Clean sump tanks

November

- Check HID bulbs and replace as needed

December

- Check vent motors and vent arm alignment, lube racks & tighten pinions

Growth Chamber Maintenance as recommended by manufacturer

Semi-Annual Inspection

1. Check for any unusual vibration and noises.
2. Thoroughly check for any refrigerant leaks.
3. Check and record amperage and voltage.
4. Inspect main electrical components.
5. Inspect relays and contactors.
6. Check and record compressors operating oil levels.
7. Check compressors unloading/capacity control mechanism(s).
8. Check for evidence of moisture in refrigerant circuit.
9. Check and record refrigerant sub cooling and superheat.
10. Check and record air temperature entering and leaving the evaporator coil.
11. Check crankcase heater operation.
12. Check and record compressor voltage and amperage.
13. Check electrical wire for evidence of overheating.
14. Check compressor motor windings with Meg-Ohm meter and record readings.
15. Inspect condenser and evaporator coils for heat transfer loss.
16. Report any major failures and repairs needed.

Desiccant Maintenance

1. Turn the dryer heaters off and allow heaters to cool-off before the blowers are stopped
2. Carefully remove the filter elements
3. Clean or replace the filter elements
4. Air blow or vacuum the filters to remove accumulated dust and fines
5. Do not puncture or distort the filters
6. Replace filter elements if they are damaged, distorted or can't be cleaned
7. Carefully re-install filter elements so no leaks are allowed around the base of the filter or the filter housing or lid.

Quarterly Inspection:

1. Check air over coils: Return Discharge .
2. Check blower for cleanliness including bearings and shaft.
3. Check all safety controls for proper operation.
4. Check all electrical connections, contactors, etc., and tighten.
5. Check and record voltage at unit at full load.
6. Meg compressor windings in the spring and record.
7. Check compressor crankcase heater.
8. Check oil level if possible. Acid check in spring.
9. Check for refrigerant leak if system is short.
10. Check condenser and clean if necessary.
11. Check for any unusual vibration and noises.
12. Check condensate drain and lines for blockage.
13. Check and record amperage: Running/ Starting
14. Check and record pressures: Suction/ Discharge .
15. Check belts and adjust if necessary.
16. Check system for proper superheat and sub cooling.
17. Report needed repairs.