

# Biosafety of Plant Research In Greenhouses and Other Specialized Containment Facilities

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## Plant Biosafety

Plant biosafety measures mitigate risks to the natural or managed ecosystem, but are rarely used to protect humans from harm. Containment facilities are designed to prevent unplanned release of contained material into the environment. Research organisms found in containment that may harm the environment include:

- Transgenic plants and associated organisms
- Exotic plants and pests
- Plant and insect pathogens
- Insect pests, predators, and parasitoids
- Plant-made pharmaceuticals
- Plant-made industrial compounds
- Quarantined materials
- Dual-use pathogens/Select Agents

## U.S. Regulation and Oversight

- **USDA-APHIS** [aphis.usda.gov](http://aphis.usda.gov)
  - Plant Health (PPQ)
  - Biotechnology (BRS)
  - Agricultural Select Agent Program [www.selectagents.gov](http://www.selectagents.gov)
- **FDA** <https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Biotechnology/default.htm>
- **EPA** <https://www.epa.gov/regulation-biotechnology-under-tsca-and-fifra>
- **NIH** [osp.od.nih.gov/office-biotechnology-activities/biosafety/nih-guidelines](http://osp.od.nih.gov/office-biotechnology-activities/biosafety/nih-guidelines)
- State Departments of Agriculture
- USDA-ARS

## Universal Biohazard Symbol

Charles Baldwin, an engineer at the Dow Chemical Company, developed this symbol in 1966 to denote human risks from biological materials. He solicited designs from Dow colleagues who offered 40 symbols that met particular criteria. The symbol needed to be:

1. Striking in form, in order to draw immediate attention;
2. Unique and unambiguous, in order not to be confused with symbols used for other purposes;
3. Quickly recognizable and easily recalled;
4. Symmetrical, in order to appear identical from all angles of approach; and
5. Acceptable to groups of varying ethnic backgrounds.



## Containment Facilities



## Biosafety Levels

### NIH Guidelines Appendix P (Plants)

- Exempt - No special facility or procedures, low environmental risk
- BL1-P - Moderate containment, obtainable in most research greenhouses, chambers, or growth rooms
- BL2-P - Higher containment yet still achievable in standard facilities
- BL3-P - High containment that requires specialized facilities
- BL4-P - Highest containment that poses serious potential risk to the environment **and** researchers

### USDA-ARS

BSL-3-Ag - High containment where facility itself is primary containment barrier

### USDA-APHIS-PPQ

No biosafety levels *sans* Select Agents, referenced as BSL-3-Ag

## Plant Containment Symbol

This plant containment symbol serves to counter the misapplication of the universal biohazard symbol. While it is important to identify plants grown under containment, seldom is there a risk to humans. The universal biohazard symbol is reserved for appropriate risk situations to ensure its validity.



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## Design Considerations

- Siting
- Layout
- Structure
- Glazing
- Entry and Vestibules
- Floors
- Drains
- Screening
- Air Filtration and Pressurization
- Cooling, Heating, Ventilation,
- Humidity
- Benching
- Computer control
- Lighting
- Utilities and piping
- Special hardware



High Containment Layout

## Management Considerations

- Access
- Apparel and Hygiene
- Contingency Plans
- Entry and Exit Log
- Inspections and Audits
- Pest Control
- Records
- Security
- Seed/plant transfer and storage
- Signage
- Termination and Disposal
- Training and Reference Manuals



**Portable VHP Sterilizer**  
30 to 35% hydrogen peroxide is delivered as vapor for surface sterilization.

## How to Use the Plant Containment Symbol

1. Post the symbol on any greenhouse room, growth chamber, growth room, or laboratory where plant research requires containment.
2. A requirement for containment may be triggered by many factors, for example: transgenic organisms per NIH or local guidelines (e.g., BLx-P); regulated material (e.g., USDA-APHIS-PPQ permitted); quarantined material per State Regulations for Noxious Weeds; etc.
3. If the plant research **does** pose a risk to human health, then the UBS symbol alone or in addition to the plant containment symbol may be used.
4. To clarify the activity signified by the containment symbol, create signage or incorporate into existing signage an appropriate description, such as: 'Containment Level BLx-P'; 'USDA-APHIS permit #xx'; or 'Quarantine'; etc.
5. The symbol is available free of charge but cannot be reproduced for sale or for commercial purpose without express permission. Email your request to [dannadair@frontiernet.net](mailto:dannadair@frontiernet.net).

## Reference

Biological Safety: Principles and Practices, 5th edition. Wooley, D. and Byers, K, ASM Press, 2017.