



Canadian Food
Inspection Agency

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CFIA - ACIA

National Voluntary Farm-Level Biosecurity Standard for the Greenhouse, Nursery and Floriculture Sectors

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Preface – How to Use this Document

The standard is a national biosecurity principles reference document to support the development and implementation of best management practices in a place of production.

As this standard applies to the greenhouse, nursery and floriculture sectors not all strategies may be available or applicable for each place of production. To develop an effective biosecurity plan the specific pests of concern for a commodity and place of production must be identified and the pathways of transmission must be analyzed.

A glossary of terms is included in the standard. *The terms in the standard that are defined in the glossary appear in bold and italic the first time they are used in the standard.*

The **Target Outcomes** are goals that all producers in the greenhouse, nursery and floriculture sectors should try to implement to protect their place of production from the introduction and spread of pests.

The **Benefits** sections provide the reader with details regarding why a specific target outcome is important to on-farm biosecurity.

The **Considerations** sections provide examples, guidance and suggestions for reaching the Target Outcomes (the goal). The intent is not to prescribe but rather to provide guidance. These are not necessarily all-inclusive but are accepted as best management practices for the GNF sectors. They are based on an understanding of risk pathways, supporting science and time proven farm-level management practices. These are designed to be attainable and realistic.

A producer guide has been developed for each sector identified in this standard. The producer guides provide more detailed, sector specific best management practices and other options to be considered to achieve the risk mitigation goal identified in the standard. These reference documents should be used with consideration for other commodity specific references that may be available from provincial and trade associations.

1.0 Introduction

1.1 What is Farm-Level Greenhouse, Nursery and Floriculture Biosecurity? Why is it important? Who is responsible?

Biosecurity refers to a series of management practices designed to prevent, minimize and manage the introduction, spread, and release of plant **pests**. This includes pests not established in Canada, pests established in limited areas of Canada, and pests widely distributed that can spread from farm to farm. The implementation of farm-level biosecurity in Canada protects our environment, viability of the agricultural sector and supports our reputation as a safe and reliable trading nation. This has significant economic, environmental and community benefits for all Canadians.

The Canadian Food Inspection Agency (CFIA) works with stakeholders to develop national voluntary farm-level biosecurity standards and producer guidance documents for several crop and animal-based sectors. The development process is supported by Agriculture and Agri-Food Canada (AAFC) under the Growing Forward 2 Agricultural Policy Framework. In order to ensure that what is developed is relevant and useful for producers and the sector as a whole, Biosecurity Advisory Committees (BACs) have been developed which pull together expertise from sector and producer organizations, producers, academia, and federal and provincial specialists. See Appendix 4 for partnership acknowledgments.

Using the North American Industry Classification System (NAICS) the Greenhouse, Nursery and Floriculture Industry Group has been deemed as one of the priorities for biosecurity standard development. Examples of these sectors are described by NAICS and include the following:

- Food crops grown under cover for example: fruit, berry¹, herb and spice or vegetable food crops grown in greenhouses or under cover. The biosecurity guidance provided in this document may also be applicable to other structures that do not meet the criteria of the greenhouse definition as provided by the glossary, such as hoop houses, shade houses or high tunnels;
- Establishments primarily engaged in growing nursery products, trees and short rotation woody crops that have a typical growth cycle of less than ten years, for

¹ For more biosecurity information for growing fruit and tree nuts refer to the National Voluntary Farm-Level Biosecurity Standard for the Fruit and Tree Nut Industry.

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example: field nurseries, fruit stock, ornamental plants, shrubs and trees that are nursery grown, and tree and shrub farming on short rotation;

- Establishments primarily engaged in growing, in greenhouses or in open fields, floriculture products and propagating materials, for example: floriculture, flower farming, flower seed production, production of cuttings for propagation, flower plant and bulb growing, cut or potted flowers, tropical foliage and green plants that are greenhouse grown;²
- Mushroom and turf sod production are not included in this reference document.

Based on Statistics Canada information from 2011, the Greenhouse, Nursery and Floriculture (GNF) sector in Canada represents 7% (7,800) of all crop farms in Canada, and 4% of all farms, including animal production. Statistics Canada information from 2014 indicates that according to farm cash receipts, the GNF sectors account for 10% (\$3 billion) of all crop farms in Canada and 5% of all farms. These sectors also represent about 25% (76,285) of all employees in agriculture. In addition, the GNF sector accounts for 26% (\$1 billion) of horticulture exports. As such, the GNF sectors are critical for agricultural revenues, and especially for employment and incomes. All Canadians benefit from the economic linkages between the GNF sectors and other economic sectors in Canada.

There are differences within the **greenhouse**, nursery and floriculture sectors in terms of species produced, potential for pest introduction, region, climate, and production practices. Growers use a range of production systems which come with varying degrees of risk, for example, field soil, growing media or a complete hydroponic system. However, it is recognized that regardless of some production differences, the implementation of proactive biosecurity measures can mitigate the potential for introduction and spread of pests when applied at critical points in the cycle of transmission.

The *National Voluntary Farm-Level Biosecurity Standard for the Greenhouse, Nursery and Floriculture Sectors* (subsequently referred to as the “Standard”) identifies key risks, target outcomes, considerations, and critical points of biosecurity interventions, based on pest introduction and transmission pathways. The level of risk for any given **place of production** will vary based on several factors. These factors may include but are not limited to; plant produced, potential for introduction, region, climate, and production practices. The implementation of proactive biosecurity measures can mitigate the potential for introduction and spread of pests if applied to break the cycle of

² Assessment of Industry Readiness for the Development of a National Farm-Level Biosecurity Standard for the Greenhouse, Nursery and Floriculture Industry

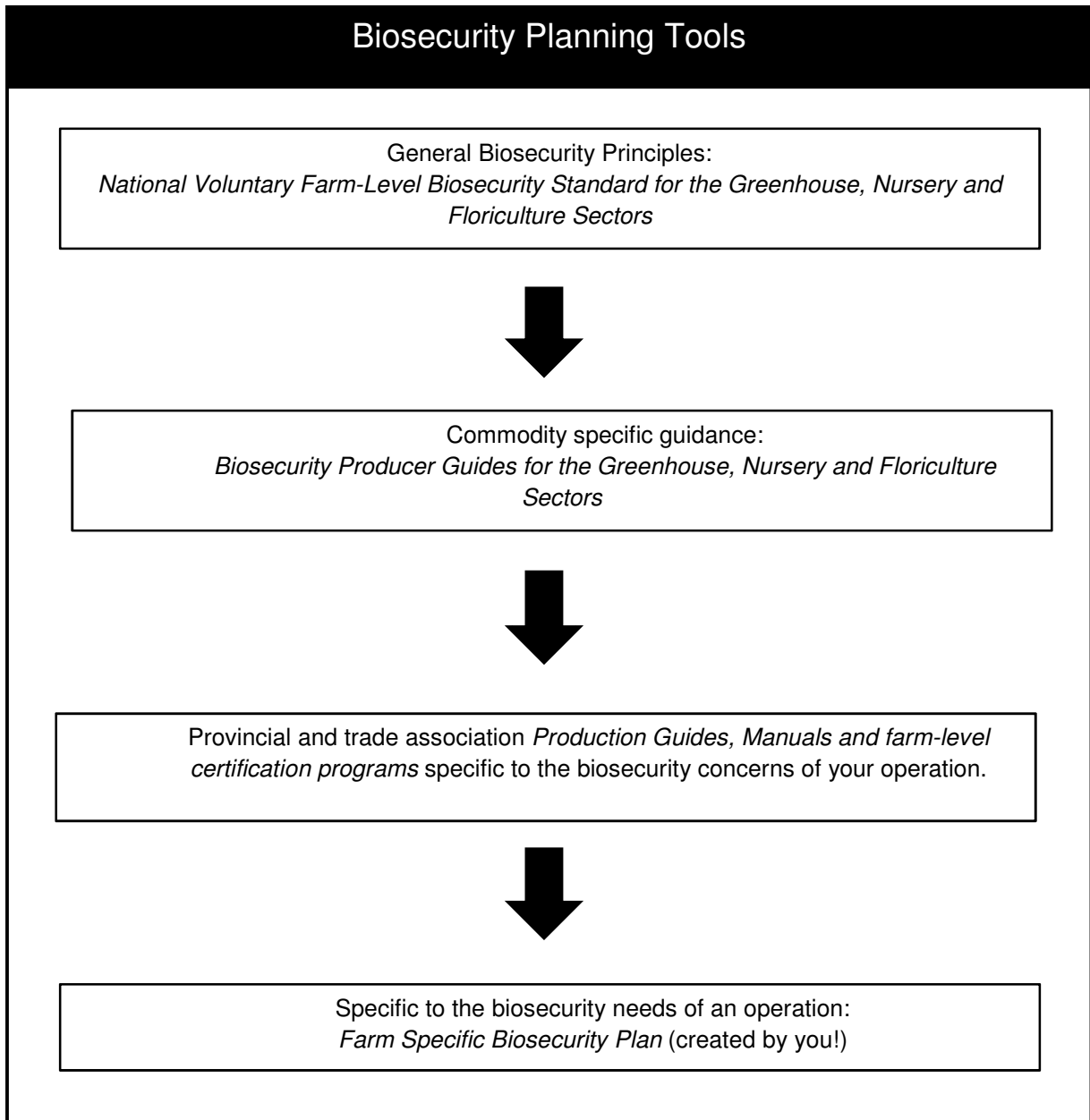
transmission. Considerations as to why someone may want to implement biosecurity measures within an operation include:

- Business objectives in order to maintain markets;
- Customer demand for biosecurity practices and protocols;
- Decreased production losses;
- Avoiding the introduction of pests that are currently not present;
- The desire to contain and minimize pests that are already present;
- Responsibilities to neighbours and industry to ensure that biosecurity risks are not introduced to someone else.

Proactive biosecurity at the place of production is only one level of biosecurity. Beyond those plant health related activities that occur at the place of production, there is the need for broader education and outreach from retailers to the consumer level to protect plant health in Canada. Biosecurity is the responsibility of everyone. It is recommended that anyone responsible for the health of plants from small farms, to large facilities, consider developing a written biosecurity plan. Measures built into everyday management practices will go a long way toward protecting a place of production from the costly consequences of pests.

Industry and provincial and federal government agencies have worked in collaboration to develop and implement a variety of farm-level certification programs. The framework of the standard builds upon these strengths, and provides a national farm-level biosecurity standard for the GNF sectors. The standard provides guidance for the development of individual farm biosecurity plans or to enhance but not supersede existing farm level programs, such as CanadaGAP™ and other regional or provincial programs. Figure 1 shows how the documents and tools referenced in this standard support the development of farm-specific biosecurity plans.

Figure 1: A visual representation of how the various documents and tools referenced in this standard work together to help in the development of a farm specific biosecurity plan



Development of your biosecurity plan for your farm should start with the general biosecurity principles of the National Voluntary Farm-Level Biosecurity Standard for the Greenhouse, Nursery and Floriculture Sectors. Then commodity specific guidance from the Biosecurity Producer Guides for the Greenhouse, Nursery and Floriculture Sectors and provincial and trade association production guides, manuals and farm-level certification programs that are specific to the biosecurity concerns of your operation

should be considered. This will help you address and include the specific biosecurity needs of your operation in your farm specific biosecurity plan.

1.2 Elements of a Biosecurity Plan

The implementation of biosecurity principles in a place of production can be seen as a continuum of activities. Figure 2 provides a visual representation of the cycle of biosecurity activities, where the need to assess and re-assess can be seen as both the starting point of the cycle as well as the activity that continues the cycle. The practice of creating a biosecurity plan is a preventative approach to manage pest risk within the place of production. By assessing and re-assessing pest risk on a regular basis, continuous improvement can be achieved and activities which were once reactive, become measured and predictable.

Figure 2: Cycle of biosecurity activities

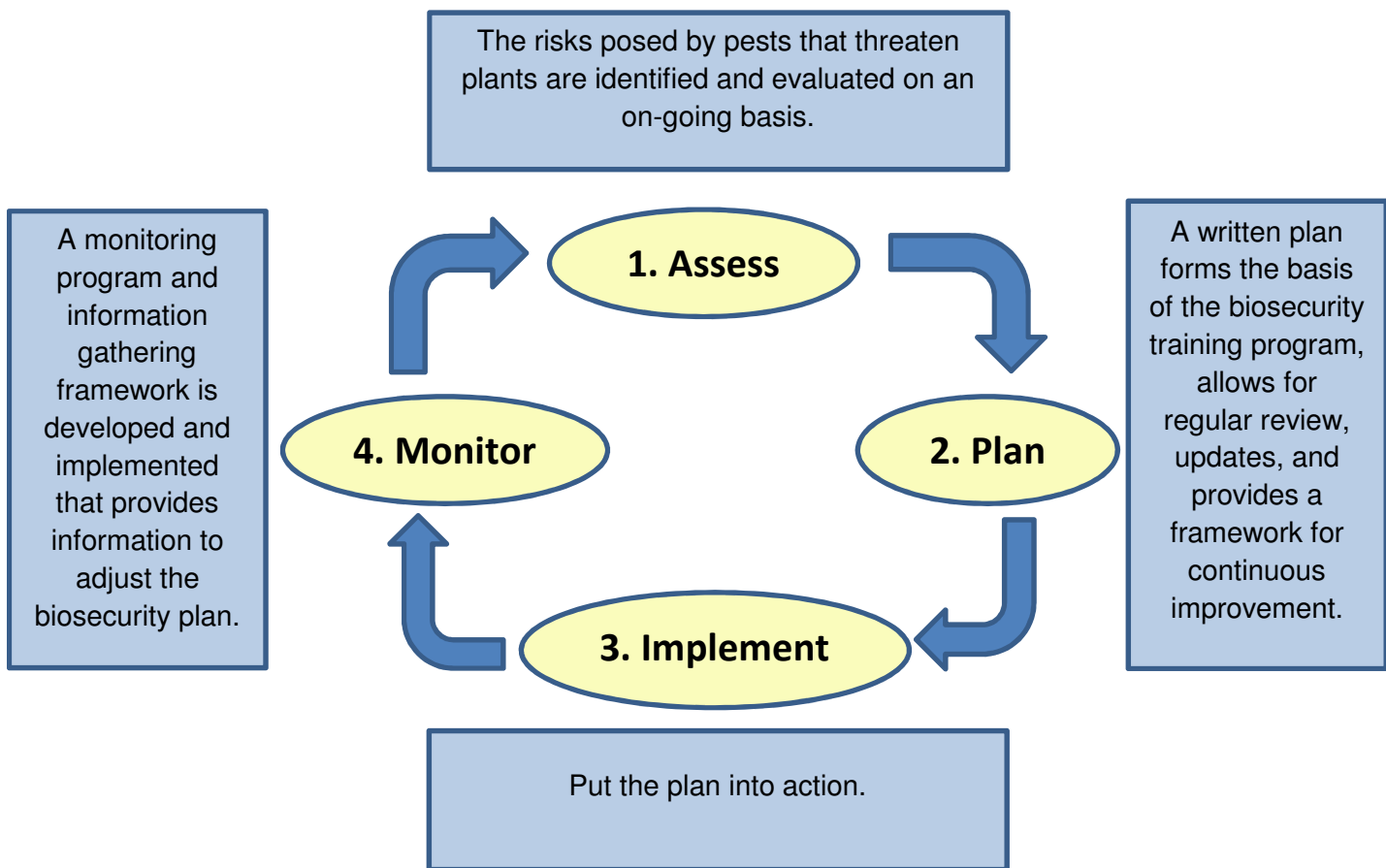


Figure 2 is an illustration of the cycle of activities that should be completed to develop and implement a biosecurity plan. The cycle of biosecurity activities has four items in the centre with arrows pointing between them in clockwise direction. The first item at the top of the cycle is Assess. Moving clockwise, the second item is Plan, the third item is Implement and the fourth item is Monitor. There is a text box by each of these items in the cycle (four in total). Above the word Assess there is a box with the following text: The risks posed by pests that threaten plants are identified and evaluated on an on-going basis. To the right of the word Plan there is a box with the following text inside: A written plan forms the basis of the biosecurity training program, allows for regular review, updates, and provides a framework for continuous improvement. Below the word Implement is a text box with the following text inside: Put the plan into action. To the left of the word Monitor is a text box with the following text: A monitoring program and information gathering framework is developed and implemented that provides information to adjust the biosecurity plan.

- **Assess:** Identify and evaluate the risks of pest introduction and analyze their pathways of transmission. This will allow for current biosecurity gaps within a place of production to be addressed. Production practices should be reviewed frequently (re-assess) to ensure that implemented measures are effective in relation to pest prevention and control.
- **Plan:** A written biosecurity plan is highly recommended. A written plan allows for regular review and update, facilitates continuous improvement within the place of production, and forms the basis for training. Note: the self-assessment tool (Appendix 1) provides a framework or starting point for the development of a biosecurity plan.
- **Implement:** Put the plan into action. Education, training and communication are key to implementing a biosecurity plan.
- **Monitor:** A monitoring program is developed and implemented for early detection, identification and ongoing monitoring of pests. It is important that the design, effectiveness and implementation of a biosecurity plan be assessed not only on a routine basis but also when changes in farm practices or biosecurity threats occur.

1.3 The Organization of the Biosecurity Principles

For the purpose of this document the principles of biosecurity have been grouped into three general areas that are important to a biosecurity plan.

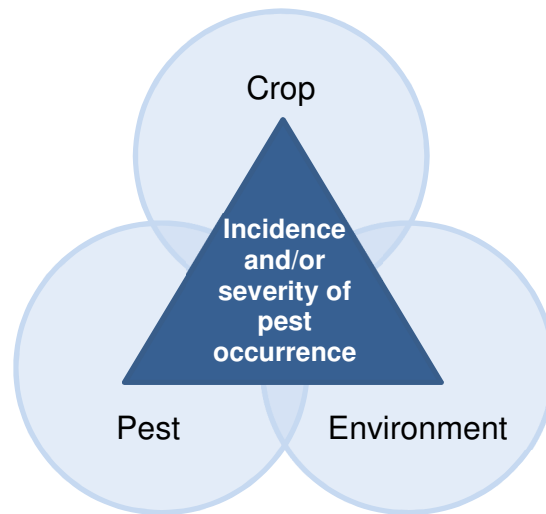
1) Plant Health Management

- Proactive measures to promote healthy plant growth and to mitigate pest occurrence (Best Management Practices, management of the crop environment and managing pest **vectors**);
 - Measures to detect and quantify pests (monitoring); and
 - Measures to respond to pests (standard operating procedures for commonly encountered pests or response planning for pests of greater concern, such as quarantine pests).
- 2) Farm Operational Management
- The location and layout of a place of production;
 - Risks associated with the continuum of activities within the place of production;
 - Risks associated with how people, tools and equipment are moved within a place of production;
 - Risks associated with receiving **inputs** (propagation materials, growing media and irrigation water) into a place of production; and
 - Risk of final products and waste leaving a place of production in the form of **outputs**.
- 3) Education, Training and Communication
- It is important to educate and inform, **service providers** and visitors regarding the importance of respecting the biosecurity measures of a place of production.
 - Train employees on the biosecurity measures that are implemented within a place of production.

2.0 Plant Health Management

The implementation of an effective biosecurity plan can promote plant health. Multiple factors can individually and collectively affect the health status of a plant such as soil quality, water quality, presence of pests and environmental factors.

Figure 3: The Plant Pest Triangle



The Plant Pest Triangle has a triangle with the words “Incidence and/or severity of pest occurrence” written on it. Each point of the triangle has a circle surrounding it. Starting at the top, the first circle says: Crop. To the right, the second circle says: Environment. To the left, the third circle says: Pest.

Figure 3 illustrates the relationship between a pest, the environment, and the crop. Pest outbreaks do not happen in isolation, they are dependent upon the interrelated nature of these three factors. The Plant Pest Triangle shows that the incidence and severity of an outbreak relates to the interaction of a susceptible crop, a pest, and an environment favourable to pest development. Plant pests may be mitigated through the application of biosecurity measures to reduce the risks presented by these three components. Specific plant types such as tolerant varieties and management of the environment may mitigate the severity of the outbreak if a pest has been introduced.

It is recognized that it may be possible for a pest to be introduced to a place of production where a host crop is not present (for example: pests can be present in potting media). There are conditions where the environment provides favourable bridging conditions which allow for pests to survive. It is also recognized that these conditions, without the presence of a host crop, would likely allow for pest introduction, but not pest proliferation.

Plant health management includes four key areas:

- Management practices, for example, management of crop environment to promote healthy growth (for example: crop nutrition, irrigation and greenhouse climate);
- Management of pest vectors;
- Pest monitoring to detect and quantify pests; and
- Responding to a pest with an ***Integrated Pest Management*** (IPM) program for commonly encountered pests or response planning for pests of greater concern, such as quarantine pests.

2.1 Management Practices

Target Outcome:

The combination of Best Management Practices and the implementation of biosecurity measures optimize the production of healthy plants.

Benefits: Best Management Practices (BMPs) that optimize production may promote the growth or introduction of pests. Complementing BMPs with biosecurity measures can optimize production of healthy plants.

Considerations

Internal and external environment

- It is recognized that intentional or managed plant stress (such as generative/vegetative production or hardening off) can be a tool for production. However, plant stress can increase plant susceptibility to pests resulting in an increase in the severity of damage.
- Environmental stress, such as frost damage or water stress can also increase crop susceptibility to pest attacks and the severity of pest impact. Reducing plant stress by maintaining optimal environmental controls and protecting against inclement weather can minimize pest outbreaks.
- Growing conditions should be managed to support crop growth while minimizing the crop's susceptibility to pest attack. Growing conditions such as high humidity can promote the establishment of some pests (fungus or mold). In these situations where growing conditions may create risks, counter measures such as increased airflow or increased plant spacing should be considered to minimize potential outbreaks.

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- Establishing a weed-free buffer around the place of production or crop and maintaining the area surrounding a production area (for example: regular mowing) may reduce the risk of pest introduction from weeds.
- Physical injury to plants from equipment, pruning or environmental conditions (for example: hail, frost and heavy rains) can make the plant more vulnerable to pest attacks and damage.

Nutrients, growing media and water management

- Ensure that an adequate fertilizer program is in place, as nutrient deficient or over-fertilized plants are more vulnerable to pests.
- Crop rotation may be used to disrupt the lifecycle of pests.
- Soil and growing media may contain pests. If a pest is present in the soil or growing media at a threshold that may cause damage to plants, then treatment of the soil or growing media may be necessary prior to planting. Treatment options include heat pasteurization, solarization or fumigation.
- Water quality and quantity may impact the health of a plant and increase vulnerability to pests. Scheduled testing of water for pathogens, nutrient levels, pH and salt level will identify potential issues that may impact the health of plants.
- If recycling water, it is recommended that a treatment system be considered.
- Different types of irrigation systems such as flood, drip, hydroponics, and overhead irrigation pose different plant health management concerns. Become familiar with common problems posed by the type of irrigation system of the place of production.

Plant material selection

- When possible, choose pest tolerant varieties or cultivars.
- Recognize there are different pest risks associated with different sources of plant material.

Crop protection products and approaches for commonly occurring pests

- Implement an Integrated Pest Management (IPM) program. IPM is a decision-making process that takes many factors into account when deciding upon a treatment.
- Be aware of secondary impacts of actions that are taken to treat pest pressures. For example, chemical pesticides can cause phytotoxicity and harm **biological controls**. There can also be negative interactions between biological controls. Detailed records of all treatments applied and responses of pests and natural

enemies can help identify conflicts. Impacts of insecticides on insect natural enemies can be researched on online databases before application.

- Pest thresholds³ for non-regulated pests may be established to trigger the use of a particular treatment. It should be recognized that what constitutes a threshold is complex as there are different thresholds for different crops and pests. Within the decision of thresholds for treatment there is a difference between suppression, eradication, and management.
- Develop a pesticide resistance management strategy⁴. Pesticides in different chemical classes⁵ should be regularly rotated to avoid developing a pesticide-resistant pest population. Pests on imported plants or cuttings may already be resistant to pesticides used in Canada. Obtain the details from the supplier of the chemical program used on any imported material to inform IPM decisions.
- Co-mingling of new plants or product coming into the place of production with older material and mother stock should be avoided. Production and the flow of propagative material and plants within a place of production should move in one direction only.
- Activities on neighbouring farms such as harvesting may increase the risk of pests entering a greenhouse through vents or other openings. When this occurs additional methods of pest control may need to be considered, such as prophylactic release of biological control agents, or the use of pesticides or mechanical controls (for example: mass trapping).

2.2 Pest Vectors

Target Outcome:

Implementation of biosecurity measures at critical points in pathways of pest transmission.

Benefits: Managing vectors and interrupting the pathways of pest transmission can reduce crop damage and minimize economic losses. The implementation of proactive biosecurity measures can mitigate the potential for introduction and spread of pests if

³ For regulated pests the **threshold for reporting** is zero, this means that one pest would trigger reporting, and would likely trigger a response.

⁴ Resistance develops because each time a product is used, the strongest pests survive. With each application we are genetically selecting for those pests that have resistance to the product being applied. Over time this creates general resistance to the product in the pest population.

⁵ Insecticide Resistance Action Committee (IRAC), Fungicide Resistance Action Committee (FRAC) and Herbicide Resistance Action Committee (HRAC)

applied to a critical point in a pathway of transmission. Pathways of pest transmission include:

- **Biological vectors** such as insects, birds, mammals and workers within the place of production
- **Physical vectors** such as packing materials and equipment
- **Environmental vectors** such as wind and surface water

Considerations:

- Inspect all inputs (new plants, propagative material, and packing material) for the presence of pests prior to accepting or moving the materials onto or within the place of production, if possible. Insects may be more visible than diseases.
- Receive, inspect and store inputs in a designated area away from production areas to prevent introduction and spread of pests to plants.
- All new plants or propagative material should be placed in isolation for a period of time to monitor and identify pests that may be present. This is important for places of production where mother plants are a part of the production cycle. If isolation is not possible, other options such as increased monitoring may be considered.
- If unfamiliar with the source of material, greater importance should be placed on segregating and inspecting the material thoroughly for pests.
- Insects may act as vectors for pests of concern and this risk should be considered in an Integrated Pest Management (IPM) program.

2.3 Pest Monitoring

Target Outcome:

Minimize production losses through the early detection of pests.

Benefits: The development and implementation of a monitoring program allows for the detection of new and common pests. Monitoring is essential to determine when pests are about to reach a threshold and control measures should be implemented. A routine monitoring program will also allow for the assessment of the effectiveness of control measures, production practices and treatments. Routine monitoring includes inspection of new plants when they arrive at the place of production and of plants in production.

Considerations:

- It is recommended that a monitoring program be developed which highlights susceptible times in the production cycle (for example: flowering), or periods where control options are more likely to be successful or cost effective.
- Monitoring can be both informal and formal. Informal monitoring is constant and undertaken to detect pests. Formal monitoring is a planned systematic process to detect and quantify pests. This information is used to decide when to implement control measures. Both types of monitoring may be included in a monitoring program.
- Maintain records of monitoring activities, especially pest finds. Records can be used in future years to predict times of high risk. Elements to be recorded might include location, date, crop type, control strategy implemented and the success of this strategy.
- Educate employees in the identification and symptoms of pests. Consider providing pest fact sheets or information sheets that explain how to identify pests of concern. See section 4.0 for further information on the importance of training and communication elements of a biosecurity plan.
- Employees are informed of the process to report pest detections.

2.4 Responding to a Pest

Target Outcome:

An Integrated Pest Management (IPM) program is developed to respond to common pests. Formal response plans are created for pests of greater concern.

Benefits: When a pest is detected there is a decision making process that involves analysis to determine if a response is required, the timing of the response as well as the identification of the most appropriate control. When a pest is found, control actions may not always be required as not all pests carry the same risk. Creating an Integrated Pest Management (IPM) program and formal response plans involves analyzing the pest risk to determine the level of response required. Preparing detailed response plans or procedures prior to the identification of a pest may facilitate an effective and timely response which may reduce production losses.

Considerations:

Unregulated pests

- When an unknown pest is detected, preserve a sample to allow for accurate identification.
- Infested material should not be mixed or come in contact with other product to limit the spread of a pest.
- Prepare an IPM program that describes a process to quickly build a situation-specific response to a pest find. The process should include confirmation of pest identification as well as determination of pest risk and control measures.
- For unknown pests, use laboratories, extension specialists, consultants, researchers and the Canadian Food Inspection Agency (CFIA) for confirmation of pest identification.
- Enhanced monitoring may be necessary when a pest has been found to quantify the level of infestation or assess the effectiveness of applied control measures.
- Pests introduced to a place of production through imported plants or cuttings may already be resistant to pesticides available in Canada. When resistance is encountered, alternative control methods such as biological control may be considered.
- Periodically evaluate the effectiveness of the pest management plan to foster continuous improvement and efficiencies.

Regulated Pests

- When a regulated pest⁶ is identified, the CFIA and the respective provincial or territorial government must be contacted to report the detection. In the response plan include the contact information of the local CFIA office, provincial extension specialists and sector association(s).
- If the detection of a regulated pest is suspected, limit the potential spread of the pest through the control or restriction of movement of plant material as well as people and equipment in and out of the infected area.
- Periodically evaluate the effectiveness of the response plan to foster continuous improvement and efficiencies.

⁶ For a list of pests regulated in Canada please refer to <http://www.inspection.gc.ca/plants/plant-protection/pests/regulated-pests/eng/1363317115207/1363317187811>

3.0 Farm Operational Management

Farm operational management is fundamental to the development and implementation of a biosecurity plan. Evaluation of the risks associated with the activities that take place at the place of production is necessary. Potential biosecurity risks can originate from the location of the place of production, the movement of people, vehicles and equipment as well as production inputs and outputs.

3.1 Location and Layout

Target Outcome:

Knowledge of the location and layout is used to evaluate new sites and to protect existing or neighbouring sites.

Benefits: The natural environment surrounding a place of production is important for identifying the source and nature of potential pests in the area. Understanding the layout of a place of production and neighbouring places of production is vital information for helping to reduce the risk of pest introduction and spread. The ability to illustrate the layout of place of production can assist in training new employees, directing visitors, and planning future production processes. Understanding the logic of crop movement and work patterns is important in developing, implementing and modifying a biosecurity plan. The integration of all knowledge when choosing the location of a place of production and when designing the layout will help optimize the success of planting objectives.

Considerations:

Geography and environmental factors

- Plant on sites that are not at risk of pest introduction by the prevailing wind direction as wind can carry pests such as spores or insects.
- Select sites that are free of the pests of concern.
- Make use of topography to assist with drainage and reduction of standing water in production areas. Drainage patterns and surface water movement can affect the potential for pest introduction and distribution.
- Asses the below ground concerns such as compacted subsoil and low water-holding capacity that may impede drainage.

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- Consider water availability, quality and accessibility.
- For plants that will be grown in open fields, conduct an assessment of the history and previous use of newly acquired or leased land. This will provide knowledge of the pests which might be of concern, and will also provide information on the potential build-up of chemical control products.

Layout

- Neighbouring activities such as type of crop in production, timing of harvest, composting practices, the importation of produce or non-agricultural activities may be the source of pest introduction. It is recommended to use this information to make risk management decisions on site selection.
- Production and propagation areas should be considered areas of higher risk for pest introduction. When considering the layout of the place of production designate separate areas for processing, production and propagation. Additional biosecurity measures may be required for processing plant material that was not grown within the place of production.
- Locate designated receiving areas for inspection of propagation materials away from production areas. The receiving area should also allow for cleaning and treatment, if necessary.
- Locate designated areas for holding and disposal of crop waste, manure, growing media or compost away from areas where plants are propagated or grown to prevent pest introduction and spread. Consider wind direction and surface drainage when locating designated areas as they may re-introduce pests to production areas.
- Locate washing facilities for cleaning and disinfecting equipment and vehicles in a low risk area that prevents pest introduction and spread. Consider the capacity for water supply, waste water collection and disposal.
- Develop a map of the place of production that illustrates property lines, roadways, borders and fencing, buildings, production areas and any waterways. It is recommended that the flow of plant material be described on this map. Where activities take place indoors, consider developing a floor plan as well. Maps previously developed for Environmental Farm Plans and Food Safety Plans may be useful for this purpose.

3.2 Biosecurity Zones

Target Outcome:

Controlled Access Zones (CAZs) and **Restricted Access Zones** (RAZs) are established and communication protocols which explain the importance of these areas within the place of production are implemented.

Benefits: Specific areas of similar levels of risk are identified and demarcated providing an indication of where in the place of production and in the continuum of production biosecurity intervention is warranted. By identifying areas of similar risk within the place of production biosecurity zones can be used to separate high and low risk activities. High risk activities that may require a Restricted Access Zone include: an infested field or propagation area. Restricted Access Zones may be required to protect plant material such as mother stock or an area where a pest is present. Examples of low risk activities that may require a Controlled Access Zone include: production fields, storage and product handling areas. See Figure 4 at the end of this section for an example of designating Controlled and Restricted Access Zones in a greenhouse.

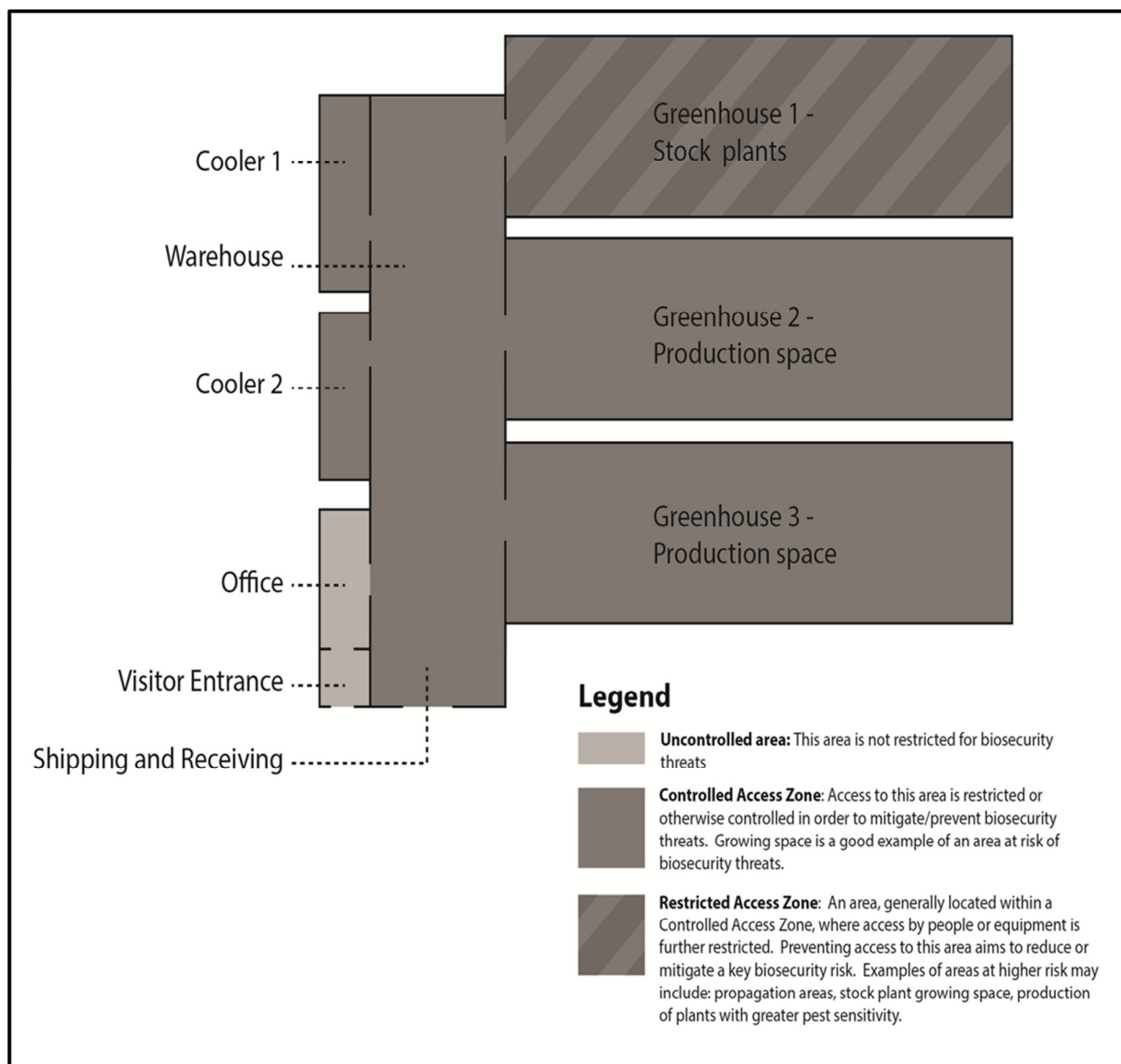
Considerations:

- Biosecurity zones are classified based on the use of an area, risk of pest spread, access to the area and biosecurity measures required to prevent the introduction and spread of pests in a place of production.
- Appropriate signs at main entrances and field approaches facilitate traffic flow as well as indicate biosecurity zones and contact numbers.
- Control entry and exit into and between biosecurity zones by designating access points and using various techniques and tools, such as signs or automated doors.
- Based on the location of the biosecurity zones, specific routes are used to move inputs, people, vehicles, equipment, and outputs to ensure pests are not spread from high to low risk areas.
- Incorporate information about biosecurity zones and traffic flow into the biosecurity plan as well as site specific training programs.
- It is recommended that there be a one-way flow of people, goods, products and equipment from clean or low risk areas to areas of a known potential risk. This may be challenging for some facilities depending on existing structures or the layout of the operation. For example, if shipping and receiving are conducted in

the same area timing can be used as a biosecurity measure to minimize the risk of potentially infested inputs contaminating final product. Figure 4 illustrates a place of production where shipping and receiving are conducted in the same area.

- Equipment that may need to move between different areas should be cleaned and disinfected when there is the need to move from high risk to low risk areas. See section 3.3 for information on the movement of vehicles and equipment.

Figure 4: Example of Designating Controlled and Restricted Access Zones in a Floriculture Greenhouse



The diagram includes three greenhouses, a warehouse space with a shipping and receiving area, two coolers and an office with a visitor entrance. The office and visitor entrance are uncontrolled areas, meaning this area is not restricted for biosecurity threats. The two greenhouses that are used as production spaces, the two coolers, the warehouse space as well as the shipping and receiving area are Controlled Access Zones (CAZ). Access to a CAZ is restricted or otherwise controlled in order to mitigate or prevent biosecurity threats. Growing space is a good example of an area at risk of biosecurity threats. The third greenhouse that contains stock plants is a Restricted Access Zone. A RAZ is an area, generally located within a CAZ, where access by people or equipment is further restricted. Preventing access to this area aims to reduce or mitigate a key biosecurity risk. Examples of areas at higher risk may include: propagation areas, stock plant growing space, and production of plants with greater pest sensitivity.

3.3 Movement of People, Vehicles and Equipment

Target Outcome:

The movement of people, vehicles and equipment do not introduce or spread pests within a place of production.

Movement of people

Benefits: Managing the biosecurity risks associated with the movement of people into a place of production and between designated areas can mitigate the risk of pests that can be carried on footwear, clothing and hair.

Considerations:

- Employees should be trained on the biosecurity protocols for the place of production; refer to section 4.0 Education, Training and Communication for more information.
- Visitors and service providers should report to the office or have an employee meet them in a designated area to receive a briefing on the biosecurity protocols.
- Visitors, service providers and employees should park in designated areas.
- Visitors, service providers and employees may only access areas that are necessary for their activities.

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- Visitors are transported about the place of production using a farm vehicle. When this is not possible, off-farm vehicles and equipment are cleaned prior to entry into the place of production.
- Keep a visitors log to identify the date visited, the areas visited and the most recent contact with greenhouse, nursery and floriculture material prior to visiting the place of production. This information may be useful when responding to a pest detection.
- Control access to restricted areas with locked gates or buildings within the place of production to authorized personnel only.
- Provide hand wash and foot bath stations at all entrances and exits of production areas. Disposable or dedicated outerwear as well as footwear should also be provided to service providers and visitors that will be entering production areas.

Vehicles and equipment

Benefits: Vehicles and equipment may harbor pests. Movement of vehicles and equipment is particularly important when coming into the place of production as well as when it is moved between biosecurity zones. Managing the movement of vehicles and equipment by designating routes, evaluating risk and implementing cleaning and disinfection, when necessary, mitigates the risk of introduction and spread of pests.

Considerations:

- Employees should be trained on the traffic flow for the place of production; refer to section 4.0 Education, Training and Communication for more information.
- Clean and disinfect equipment after it has been used in a high risk area. Thorough cleaning of equipment between uses in different production areas may mitigate the spread of pests. To minimize cleaning of equipment strategically sequence activities.
- All tools used for pruning plants should be disinfected before use and between crops or different sections within the place of production, especially if a pest is present.
- Any vehicle, such as shippers or service providers, entering the place of production may harbor pests.

3.4 Production Inputs

Target Outcome:

Production inputs are not a potential source of pests.

Benefits: Receiving inputs such as propagative material, soil, growing media, water or packaging material has the potential to introduce pests to the place of production. Pest introduction may be mitigated by evaluating the risks associated with inputs sourced from suppliers.

Considerations:

- Production inputs should be inspected for signs of pests before entering the place of production and if pests are present inputs are disposed of or cleaned and disinfected.
- If the source or risk level of inputs is unknown it may be considered high risk and segregated from final product or propagative material to allow for monitoring of pests.
- Propagative material can be the source of a pest introduction. Evaluate the risks associated with suppliers. Isolate and inspect upon entry into the place of production.
- Soil associated with field grown plants can be a source of pests. Purchase bareroot or washed material, when possible.
- Know the source and test the quality of water supplied to the place of production to manage nutrient content. Water quality is important for healthy plants.
- If required, treat recycled water to prevent the spread of pests within the place of production.
- Recyclable or reusable plastic containers should be cleaned and disinfected as necessary prior to use.
- Maintain purchasing records for production inputs. Records of the source of a production input, number of plants and date planted can be important when responding to a pest detection.

3.5 Production Outputs

Target Outcome:

Finished product leaving the place of production is free of pests of concern.

Production wastes are managed, treated and disposed of to reduce the risk of spreading pests.

Benefits: Managing outputs, final product and waste, mitigates the potential risk of pest introduction and spread within a place of production to neighbouring places of production or to areas where the product may be received (from domestic to international destinations).

Considerations:

- Quality assurance is an important consideration when product leaves a place of production. Inspect final product leaving the place of production for pests of concern.
- Effective plant health management as outlined in section 2.0 of the standard is essential to producing a high quality finished product that is free of pests of concern.
- Identify and label final product according to growing area as this is important for traceability in the event of a pest detection once the product has left the place of production.
- Locate compost piles away from production areas.
- Dispose of infected plant material by deep burial, transportation to a municipal disposal facility or other methods that minimize the risk of pest spread and introduction. During disposal it is important to prevent the release of pests as infected plant material presents a high risk of re-infecting the same crop or infecting other crops.

3.6 Maintenance of Facilities and Property

Target Outcome:

Introduction and spread of pests is limited by keeping buildings and equipment in good repair.

Benefits: Keeping buildings and equipment in good repair, in addition to cleaning and disinfecting will help limit the opportunity for the introduction and spread of pests.

Considerations:

- Develop and implement a routine facility and property ***maintenance*** program that includes preventative maintenance activities. This may include separate plans for the maintenance activities required for the interior and exterior of the place of production.
- A maintenance program for greenhouses may include a weed-free buffer around the greenhouse.
- Keep a record of maintenance activities. A checklist of activities may be used to record the timing and activities that have been completed.
- Minimize or eliminate areas where pests can enter by ensuring holes are fixed, doors close properly and windows can be closed.
- Develop and implement a procedure to clean the greenhouse, which includes cleaning the structure and irrigation system.
- Some operations are highly mechanized and this equipment is not always easy to clean. When using this machinery, inspect and verify that propagative material is free of pests of concern to mitigate the risk of pest spread.

4.0 Education, Training and Communication

Target Outcome:

People entering or working within a place of production respect the biosecurity measures in place.

Benefits: A well developed, communicated and implemented training program will provide visitors, service providers and employees with an understanding of the importance of proactive biosecurity.

Considerations:

- Including employees in the process to design the biosecurity plan can be an effective approach and may result in them taking more “ownership” of the plan, which may help with implementation.
- Incorporate biosecurity protocols into the training program.

- Signage and visual aids are used to communicate biosecurity protocols within a place of production.
- Plain language is used in education and communication materials and on signage.
- Information is provided in the appropriate language for employees. Signage, education and communication documents are translated, when necessary.
- Ensure that visitors and service providers respect the biosecurity measures for the areas of the place of production they visit. Templates and checklists may be used to verify whether biosecurity measures have been completed.
- Schedule and implement periodic training and awareness updates with employees.
- Monitor, review and update the biosecurity plan and training program as situations change and new information becomes available.
- Train employees in crop production practices, the identification of pests, symptoms of pests and response protocols.

5.0 Conclusion

Biosecurity measures help to prevent and manage the introduction and spread of pests in Canada. This National Voluntary Farm-Level Biosecurity Standard for the Greenhouse, Nursery and Floriculture Sectors provides producers with a nationally consistent approach to develop and implement a biosecurity plan. The self-assessment checklist in Appendix 1 will help producers determine the appropriate biosecurity measures for a place of production. For more information on applying biosecurity principles from the standard to a place of production, refer to the producer guides for the greenhouse, nursery or floriculture sector.

6.0 Glossary

Biological Control: Often referred to as “biocontrols”. Biological pest control is the method of controlling pests (including insects, mites, weeds and plant diseases) using other living organisms. It relies on predation, parasitism, herbivory, or other natural mechanisms, but typically also involves an active human management role. It is often an important component of integrated pest management (IPM) programs.

Biosecurity: A set of practices used to minimize the transmission of pests including their introduction (bioexclusion), spread (biomanagement), and release (biocontainment).

Controlled Access Zone (CAZ): A place of production, area within a place of production, or a field area, where access to that area is restricted or otherwise controlled.

Greenhouse: While the Biosecurity Standard uses the more general term “Greenhouse” there are in fact two distinct definitions to consider:

1) A vegetable greenhouse or hothouse means a fully enclosed permanent aluminum or steel structure clad either in glass or impermeable plastic which must:

(a) Use automated irrigation and climate control systems, including heating and ventilation capabilities; and

(b) Utilize hydroponic methods

“Vegetable Greenhouse/Hothouse Production Standards” also include:

i) Minimizing pesticide use by utilizing no herbicides and following production practices such as Integrated Pest Management; and

ii) Complying with the standards of a globally accepted Food Safety program.

A certified organic greenhouse/hothouse vegetable facility must meet the greenhouse definition, with the exception of (b), as, according to Canadian organic standards (CAN/CGSB-32.310-2006), hydroponics are not allowed and “soil” must be used as the growth medium⁷.

2) A floriculture greenhouse or nursery greenhouse is the physical location where plants are grown within, under, or sheltered by structures to provide a modified growing condition and/or protection from pests and adverse weather. These structures may include greenhouses, hoop houses, screen houses, shade houses, or other structures⁸.

Input: The resources that are used in greenhouse, nursery or floriculture production, such as chemicals, equipment, fertilizer, seed and plant material.

Integrated Pest Management (IPM): Integrated Pest Management (IPM) is a process for planning and managing sites to prevent pest problems and for making decisions about when and how to intervene when pest problems occur. It is a sustainable approach, combining biological, cultural, physical, and chemical tools to manage pests

⁷ Based on the standing policy of the Canadian Horticultural Council, resolution number LR2014-13.

⁸ Greenhouse Certification Program

so that the benefits of pest control are maximized and the health and environmental risks are minimized.

Maintenance: Involves unscheduled and routinely scheduled activities to fix any area of the place of production, device or equipment should it become out of order or broken.

Output: Includes waste, garbage and finished product.

Pest⁹: Any living organism injurious to plants, plant products or by-products which includes insects, diseases and weeds.

Place of production: For the purpose of this document the term “place of production” is used to describe a variety of operational realities, including farms, nurseries, greenhouses, packing houses, etc.

Restricted Access Zone (RAZ): An area, generally located inside the controlled access zone, where access by people or equipment, is further restricted, providing an extra level of protection.

Service Providers: Includes but is not limited to federal and provincial inspectors, delivery personnel, utility providers such as electricians and plumbers, IPM Specialists and extension specialists.

Vector: A biological, physical or environmental agent that disperses a plant pest.

⁹ “Pest” as defined in Canada’s *Plant Protection Act* “means anything that is injurious or potentially injurious, whether directly or indirectly, to plants or to products or by-products of plants, and includes any plant prescribed as a pest.”

Appendix 1: Biosecurity Self-Evaluation Checklist

Use the checklist below to conduct a self-assessment of the biosecurity measures currently implemented in a place of production. Indicate with a checkmark whether the biosecurity measure occurs (Yes) or does not occur (No) or is not applicable (NA). Carefully evaluate whether a measure is not applicable to a place of production, as measures that pertain to the place of production but are not implemented should be identified as 'No' as opposed to 'Not Applicable'. Completing the checklist will help identify areas where biosecurity measures may be required and will help provide a framework for the development of a biosecurity plan. Upon completion review the responses. Where 'No' has been checked, refer to the related section of the standard and producer guide to develop actions to implement the biosecurity measure.

Carefully evaluate whether a measure is not applicable to a place of production. It is recognized that not all measures will apply to each of the various commodities and production types included in the scope of the standard.

Date of assessment: _____

Biosecurity Measure	Yes	No	NA	Comments
Section 2.1 Management Practices				
Internal and external environment				
Optimal environmental controls are maintained.				
A weed-free or managed buffer has been established around the place of production.				
Nutrients, growing media and water management				
An adequate fertilizer program is in place.				
Soil and growing media are heat pasteurized, solarized or fumigated between uses.				
Water is routinely tested for pathogens, nutrient levels, pH and salt level.				
A treatment system is considered when water is recycled.				
Plant material selection				
Pest tolerant varieties or cultivars are chosen when possible.				
The different pest risks associated with different sources of plant materials are recognized.				

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Biosecurity Measure	Yes	No	NA	Comments
Crop protection products and approaches for commonly occurring pests				
An Integrated Pest Management program is implemented.				
Pest thresholds are established to determine when to treat non-regulated pests.				
A pesticide resistance management strategy has been developed.				
New plants or products are not co-mingled with older material and mother stock.				
Pest control methods are considered to prevent pests from neighbouring farms entering the greenhouse.				
Section 2.2 Pest Vectors				
Inputs are inspected prior to accepting or moving onto or within the place of production.				
Inputs are received, inspected and stored in a designated area away from production areas.				
New plants or propagative material are placed in isolation for a period of time.				
Section 2.3 Pest Monitoring				
A monitoring program has been developed.				
Information from formal and informal monitoring is used to decide when control measures are implemented.				
Records of monitoring activities and pest detections are maintained.				
Education has been provided to employees to identify pests and symptoms of pests.				
Employees are informed of the process to report pest detections.				
Section 2.4 Responding to a Pest				
Infested material is not mixed and does not come into contact with other product.				
For unknown pests, laboratories, extension specialists, consultants, researchers and the CFIA are used to confirm pest identification.				
An Integrated Pest Management (IPM) plan and response plans are prepared.				
Response plans and the pest management plan are periodically reviewed.				
The CFIA, provincial or territorial government is contacted when a regulated pest is detected.				

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Biosecurity Measure	Yes	No	NA	Comments
Section 3.1 Location and Layout				
Geography and environmental factors				
Sites that are not at risk of pest introduction by prevailing wind direction are chosen for planting.				
Sites chosen for planting are free of pests of concern.				
Topography is used to assist with drainage and reduction of standing water.				
When planting in open fields, an assessment of the history and previous land use is conducted for newly acquired or leased land.				
Layout				
Information of neighbouring activities is used when choosing a site.				
Separate areas are designated for processing, production and propagation activities.				
Designated receiving areas for inspection of propagation materials are located away from production areas.				
Areas designated for holding and disposal of crop waste, manure, growing media and compost are located away from areas where plants are propagated or grown.				
Designated areas for cleaning and disinfecting equipment and vehicles are located in a low risk area.				
A map of the place of production is developed.				
Section 3.2 Biosecurity Zones				
Signs are placed at main entrances and field approaches to facilitate traffic flow and indicate biosecurity zones.				
Entry and exit into biosecurity zones is controlled.				
Information about biosecurity zones and traffic flow has been incorporated into the biosecurity plan.				
People, goods, products and equipment are moved from clean or low risk areas to high risk areas.				
Section 3.3 Movement of People, Vehicles and Equipment				
Movement of people				
Employees are trained on the biosecurity protocols and traffic flow for the place of production.				
Visitors and service providers are informed of the biosecurity protocols.				
Visitors, service providers and employees only access area(s) necessary for their activities.				

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Biosecurity Measure	Yes	No	NA	Comments
Visitors and service providers sign a visitors log on arrival.				
Access to restricted areas is controlled.				
Hand wash stations, foot bath stations are provided at all entrances and exits. Disposable or dedicated outerwear as well as footwear is provided for service providers and visitors that will enter the production areas.				
Vehicles and equipment				
Equipment is cleaned and disinfected after use in high risk areas.				
Tools are disinfected before use and between crops or different sections of the place of production.				
Section 3.4 Production Inputs				
Production inputs are inspected for signs of pests before entering the place of production.				
If the source of a production input is unknown it is segregated from final product or propagative material.				
Bareroot or washed material is purchased when possible.				
Water used in the place of production is routinely tested to manage nutrient content. If required, recycled water is treated.				
Plastic containers are cleaned and disinfected as necessary prior to reuse.				
Purchasing records for inputs are maintained.				
Section 3.5 Production Outputs				
Final product is inspected before leaving the place of production.				
Final product is labelled.				
Compost piles are located away from production areas.				
Infected plant material is disposed of by deep burial, transportation to a municipal disposal facility or other method to minimize pest spread.				
Section 3.6 Maintenance of Facilities and Properties				
A property maintenance program is implemented.				
Records of maintenance activities are kept.				
Areas where pests can enter are minimized or eliminated by regular maintenance activities.				

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Biosecurity Measure	Yes	No	NA	Comments
Section 4.0 Education, Training and Communication				
Biosecurity protocols are incorporated into the training program.				
Signs and visual aids are used to communicate biosecurity protocols.				
Information is provided to employees in the appropriate language.				
Employees are given scheduled and periodic training and awareness updates.				
The biosecurity plan and training program are reviewed and updated as new information becomes available.				

Appendix 2: Acknowledgements

- Alberta Agriculture and Rural Development
- Alberta Greenhouse Growers Association
- BC Greenhouse Growers' Association
- British Columbia Landscape and Nursery Association
- British Columbia Ministry of Agriculture
- Canadian Horticultural Council
- Canadian Nursery Landscape Association
- Canadian Ornamental Horticulture Alliance
- Fédération interdisciplinaire de l'horticulture ornementale du Québec
- Flowers Canada (Ontario) Inc.
- Flowers Canada Growers
- Landscape Ontario
- Manitoba Agriculture, Food and Rural Development
- McGill University
- New Brunswick Department of Agriculture, Aquaculture and Fisheries
- Nova Scotia Greenhouse Growers Association
- Olds College
- Ontario Greenhouse Vegetable Growers
- Ontario Ministry of Agriculture, Food and Rural Affairs
- Prince Edward Island Horticultural Association & Federation of Agriculture
- Saskatchewan Ministry of Agriculture