

# Good practices for Healthy Vegetable Seed Production

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## DISCLAIMER

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These Best Practices (BPs) are flexible and their application will differ according to the size, nature and complexity of the organization and the vegetables involved. These BPs are not exhaustive. It is the responsibility of any user of these BPs to consider the user's specific circumstances when developing a process specific to its organization, and in meeting any applicable legal requirements.

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## 1. INTRODUCTION

ISF and APSA describes Best Practices for seed production globally and expects from its members to act in line with these practices. Although these are regarded ‘Best Practices’, these are recommendations. Recommendations will always reduce the risk of disease establishment but not avoid disease establishment in seed production crops. These practices describe use of contracts, refrain from child labour and establish track and trace procedures. However, these BPs only minimally incorporate practices on how to produce healthy seeds. This document will describe in general terms what ISF and APSA considers as BPs for healthy seed production. This BPs is a supplement to the earlier adopted “Vegetable Seed Production Good Practice Guide” that ensures the integrity of the production chain from stock seed to commercial seeds focusing on intellectual property.

[https://www.worldseed.org/wp-content/uploads/2017/01/Seed\\_Production\\_Good\\_practice\\_10.01.17-final.pdf](https://www.worldseed.org/wp-content/uploads/2017/01/Seed_Production_Good_practice_10.01.17-final.pdf)

## 2. RISK ASSESSMENT

Although general rules of thumb apply for production of healthy seeds, specific risks and pathways should be evaluated for every crop and pathogen combination, depending on the local conditions, regulations and vulnerability of seeds and young plants in the seed production process to become infected with a seedborne pest. An assessment of every step in the production process needs to be evaluated for its risk and the required measures to control those risks.

Potential Infection sources.

Infection Source	Description
Seed	Seed may carry seed-borne pests and/or contaminating pests. As seed trading has become global, long distance disease transmission can happen through seed. Concerning this, try to use pest free/disinfected seed
Air	Fungal spores, insects and mites can spread by wind

Water	Can directly (rain splashes, irrigation water) or indirectly (increase humidity) spread pests
Fungi	Some pests are transmitted by fungi, mostly soil inhabited
Soil	Some bacteria, oomycetes, fungi and nematodes may persist for years in the soil as microspores, oospores, cysts, etc. and can serve as a source of inoculum in the next cropping season
Insects	Some insects are known to actively transmit plant viruses and bacterial pests
Nematodes	Some species of nematodes are known to be plant virus vectors and they are soil inhabitant
Mechanical from hands, clothes and equipment	Some viral genera are known to be mechanically transmitted as some bacteria. Wounding of plants facilitate infection because it opens ports of entry and more pests will be able to infect the plant.
Pollen	Some viruses and bacteria are known to spread via infected pollen
Adjoining fields	Adjoining fields can be a source of infection by either serving as a reservoir for a number of plant pest and disease, or by discharging drainage water that could be infected by a soil borne disease

Since all these sources can carry a pest and can put the crop at risk of infection, as much as possible must be done to control the pest sources by either removing them or confining them.

## STARTING MATERIAL

Starting material (which can be seeds, plants, cuttings, pollen, in vitro propagated plants) for seed production should be sufficiently free from pests influencing production of healthy seeds. In case of seeds as starting material, seed transmittable pests are in scope, while in case of young plants and cuttings also other pests might be in scope. Guarantees should be given to show that appropriate measures are taken to mitigate (seed transmitted) pests. These measures can encompass starting materials produced in disease free areas, field inspections, seed and plant tests, seed treatments and other mitigation measures. This information should be track and traceable in the administration of the Seed Companies and communicated to the Seed Producer on request.

In cases where no enough guarantees can be provided; the starting material should not be used for seed production. An alternative to the guarantees, is sowing in isolation, and use these plants only after inspection and when found free from disease using procedures such as seed health test. Alternatively, additional disease control must be applied to prevent establishment and dissemination of pests.

It is good practice to inform seed producers and subcontractors (e.g. by individual notification on packaging, packing list or joined documents or general statement) that all starting material complies with these general Seed and Plant health standards.

## 3.FIELD FACILITIES AND EQUIPMENT

It is good practice to monitor field history that could reveal prior contamination with soil borne diseases, the risk assessment will determine what measures are needed to produce clean seeds on this field.

Equipment should be dedicated as much as possible to a single production unit (field, nethouse, greenhouse, compartment etc). When equipment and tools are used in multiple production units, these should be appropriately cleaned and disinfected (where applicable) before use in a different production unit when these can lead to seed infection. Farming equipment should be cleaned from adhering soil and crop residue as much as possible before leaving the site.

Materials and equipment that are reused must be appropriately cleaned and disinfected (where applicable) in between cropping cycles.

Confined Facilities must be cleaned and disinfected between cropping cycles.

Soil should not be transported from one field to another field to prevent contamination of healthy crops and fields.

#### **4.CROP MAINTENANCE**

Crop maintenance is carried out by trained employees and access to the fields is limited. People not involved in inspections, maintenance or other crop specific tasks should not have access to the field. Access of animals to the fields should be prevented as much as possible.

Appropriate hygienic measures need to be available for persons accessing the field. Clear instructions before access to the field should be given by the responsible person to all workers and visitors on the hygienic measures to take. These encompass at least, minimal touching of the crop and use and compliance to relevant hygienic measures available. These might include disinfection of hands, disinfection of boots/shoes/feet/car tyres, change of clothing when appropriate. Products from related crops (e.g. food items) should be kept out of seed production fields and potential inoculum sources should be kept away from seed production crops, like for solanaceous crops tobacco. Tobacco in cigarettes is a considerable inoculum source and is frequently a source for introduction of Tobamoviruses into solanaceous crops. Therefore, no smoking/chewing should be allowed in fields or confined spaces grown to solanaceous crops, and thorough cleaning measures must be taken for hands and clothing of smokers.

Crop workers should comply with all prescribed measures provided by the management. These should encompass at least, refrain as much as possible from touching infected/suspected plants when carrying out crop maintenance. Use the provided tools and disinfectants and keep them within the dedicated growing environment or compartment/field.

When disinfectants are used in the field or at entrance these need to be kept at effective concentrations and refreshed when dirty or turn ineffective.

Preventative control measures should be applied to control pests, where possible. Vector pests should be monitored by appropriate tools (e.g. gridded glue traps). When found above a predetermined tolerance threshold control measures need to be applied. All control measures (chemical, organic) applied must be in line with local regulation and according to health and safety standards.

When known host plants are observed in the vicinity of a seed production plot, efforts should be made as much as possible, to prevent these host plants from becoming a source of inoculum contaminating the seed production crop.

At the end of the growing season the crop remains and especially those that appear infected are disposed of in such a way that potential pest spread is avoided (e.g. composted, burnt, buried in pits with activated lime, or ploughed under completely).

#### **5.CROP INSPECTION**

Every seed production should be inspected by a knowledgeable field inspector. Results of these inspections should be documented and available for every batch, including frequency,

method and results of crop monitoring. In case of doubt tissue samples can be diagnosed to identify the pest, using a field diagnostic kit or in a diagnostic laboratory, so that appropriate measures can be taken.

## **6. CRISIS MANAGEMENT – SYMPTOMATIC PLANTS**

When symptomatic plants are detected, immediately confirmation of the suspected infection must be carried out, so that appropriate measures can be taken to contain and limit the damage from a possible infection by taking all reasonable precautionary measures to prevent disease spread. These can contain, but are not limited to:

- remove and safely dispose of diseased plants to prevent pest spread or apply control measures.
- sanitation of contaminated area when appropriate.
- after removing diseased plants, hands and tools used to remove diseased plants must be disinfected, before handling other (healthy) plants.
- increase crop monitoring in nearby area when appropriate.

In case of a regulated pests, regulatory bodies should be informed according to local procedures.

## **7. SEED EXTRACTION AND SEED DESINFECTION TREATMENTS**

Fruits and plants selected for seed extraction should be free from seed transmitted diseases and visually healthy.

Seed extraction procedures are carried out in such a way that development, infection and transfer of pest from one seed batch to the other is prevented. Seed extraction equipment is cleaned extensively, and all seeds and fruit remain are removed from the seed batch completely. Wastewater is disposed of in such a way that there is no risk for secondary infection of other seed batches and crops in the immediate surroundings.

At all times pest free water for the seed handling process, seed extraction and cleaning should be used.

During wet seed extraction, seed sanitation products can be applied but effectivity and applicability depends on the crop and pest.

## **8. TEST SEEDS AFTER PRODUCTION**

Guarantees must be given that produced seeds are sufficiently free from relevant seedborne pests, prior to commercialization. Proof of pest freedom should be available until at least 3 years after full consumption of the batch. A reference seed sample should be available for

confirmation of pest freedom until at least 3 years after full consumption of the batch. The seed producer is informed about the seed health test results of the produced seed lots.

## 9. SEED PROCESSING AND SEED GRADING

Measures should be applied to prevent mixing of batches to prevent cross-contamination of healthy batches with potentially infected seeds.

## 10. USEFUL LINKS

<https://www.gspp.eu/> - Hygiene system for the production of *Clavibacter michiganensis* subsp. *michiganensis* free tomato seeds and young plants

<http://www.amseed.org/pdfs/issues/phytosanitary/bacterial-fruit-blotch-bfb.pdf> - Management of Bacterial Fruit Blotch in cucurbits

<https://www.farmbiosecurity.com.au/essentials-toolkit/people-vehicles-equipment/>

<https://www.melonsaustralia.org.au/wp-content/uploads/2019/12/Cucumber-green-mottle-mosaic-virus.pdf>

[https://www.betterseed.org/wp-content/uploads/ReFreSH-Concept-Paper-Draft\\_-2019.pdf](https://www.betterseed.org/wp-content/uploads/ReFreSH-Concept-Paper-Draft_-2019.pdf)

