

Cleaning and disinfectant can help prevent spread of the following potato diseases**In fields, spread by contaminated equipment**

Most problem pests can be effectively eliminated by removing all soil and debris from field equipment before they leave one field and enter another. Harvesters retain the most soil, followed by plows, and then cultivators.

Pests that can spread include:

- Nematodes
- Weed seeds
- Soil-borne diseases

Seed cutter (machine) is a common source of contamination for:

- Bacterial ring rot—caused by *Clavibacter michiganese*
- Bacterial soft rot—caused by *Pectobacterium spp.*
- Fusarium dry rot—caused by *Fusarium sp.*
- Late blight—caused by *Phytophthora infestans*
- Mechanically transmitted viruses such as potato virus X (PVX)

Pick planters are worse than cup planters for transmitting potato diseases because the picks are easily contaminated during planting, spreading disease from infected to healthy seed pieces.

In potato storage units where pests can survive for years

Storage cleaning and disinfection is important to minimize disease carryover from one season to the next, especially in storage facilities that had tuber breakdown due to rot or “hotspots” where tuber decay had occurred the previous storage season.

Potato pathogens can survive very long times in potato storages.

Silver scurf—caused by the fungus *Helminthosporium solani*—can survive

- At least 9 months on foam insulation and soil floors
- 3 months in plywood and sheet metal

Bacterial ring rot can survive

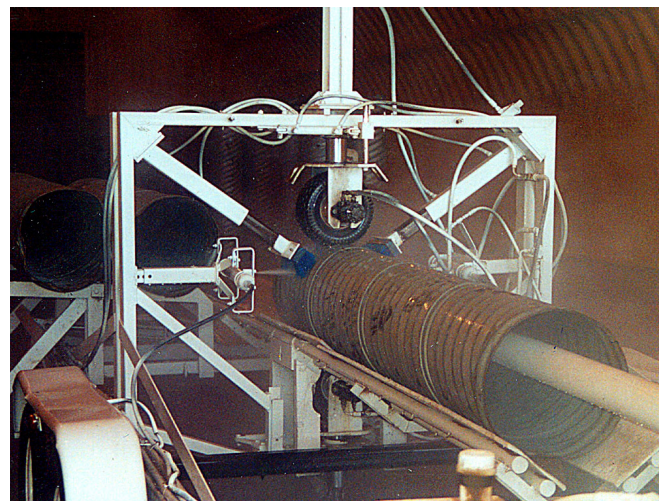
- Up to 3 years on hard surfaces
- Up to 7 years on wood surfaces

Cleaning and Disinfecting Potato Equipment and Storage Facilities

By Nora Olsen and Phil Nolte

Potato equipment and storages are exposed to a number of pests including fungi, bacteria, insects, nematodes, and weed seeds. Many of these pests can be spread from tuber to tuber or field to field on equipment or in storage and cause problems in future crops if not eliminated or at least minimized.

Some disease problems, like bacterial ring rot (caused by *Clavibacter michiganese*), can be a very serious problem for seed potato producers, even when the disease occurs at very low levels. Nematodes are easily transferred from one field to another in soil adhering to equipment that is not properly cleaned between fields.



Remember that duct pipes must be thoroughly cleaned along with the rest of the potato storage facility. You risk spreading potato diseases if your disinfection effort is only partially completed.

Photo courtesy of Potato Services of Idaho LC

One of the best methods to minimize spread or recurrence of a pest is a good sanitation program for equipment and storage facilities. Equipment is often moved from field to field or even shared among growers, a practice that makes cleaning and disinfecting even more critical. This problem is not limited to

private farms. The same issues also apply to custom operations and the purchase of used equipment.

It is imperative that all equipment be thoroughly cleaned and sanitized prior to movement into your fields for the first time. If there are known pest concerns in fields within your farming operation, it is advisable to clean equipment prior to and after movement between fields.

The terms “cleaning and disinfecting” are defined and emphasized throughout this bulletin. The simple act of cleaning is a key first step to a highly effective overall disinfection program.

Cleaning refers to the physical removal of soil and debris by sweeping, shoveling, or scraping prior to utilizing a water-and-soap-based detergent program or using some sort of steam appliance.

Soap-based detergents are important because they can break apart dried bacterial slime and plant sap or other deposits. The breakdown of these deposits often destroys the pathogens directly or degrades the material protecting these pathogens, which helps facilitate a more thorough disinfection of equipment and/or storage facilities.

The cleaning process also removes potato debris and other trash from within and around storage facilities, which has the added benefit of reducing or eliminating foreign material from the next stored crop.

Prior to disinfecting equipment or a storage facility, removal of debris and soil is also necessary to allow the disinfectant to be effective. This is very important because general disinfectants or biocides are very reactive with organic matter such as soil and debris.

If these contaminants are present in high quantities on the surface you are attempting to disinfect, the disinfectant will not perform well enough. Simply applying a disinfectant without an effective overall cleaning beforehand is not recommended.

Cleaning and disinfecting field and handling equipment

Removal of soil and debris

One of the most critical problems associated with contaminated equipment is soil. Most problem pests can be effectively eliminated by removing all soil and debris.

Keep in mind that adhering soil is a problem in all field preparation and tillage equipment and is not just

limited to dedicated potato handling equipment. The amount of soil remaining on a piece of equipment varies with the type of equipment.

Cultivators generally retain less soil than plows, which, in turn, retain less soil than harvesters.

The number one objective for equipment that is to be cleaned and disinfected is to completely remove all soil.

This task can be accomplished with pressurized water or with steam equipment. Be aware that either of these two methods can remove paint. Clean the equipment at the previous field site or take it to a non-farm site for cleaning so that contaminated soil is not moved to a new field.

Note: Removing contaminated soil at a non-farm site is a very important practice to follow when purchasing, leasing, or borrowing used equipment.



Potato handling equipment can be a serious source of contamination from adhering soil and debris. That's why thorough cleaning is advised before moving to new fields. Photo by Nora Olsen

Seed cutting and pick-style planting equipment

A seed cutter is a common source of contamination for bacterial ring rot, bacterial soft rot (caused by *Pectobacterium spp.*), Fusarium dry rot (caused by *Fusarium sp.*), late blight (caused by *Phytophthora infestans*) and, to a lesser extent, mechanically transmitted viruses such as potato virus X (PVX). This occurs because the cutting blades are in use continuously during the cutting process transmitting sap, debris, and the associated pathogens from infected seed tubers to healthy ones.

This highly effective mechanical transmission of seed decay and other pathogens dictates a strong and directed cleaning and disinfection of all cutting blades.

At the very least, cleaning and disinfection procedures need to be employed between seed lots.

The potential for contamination from one seed piece to another is greater with a pick style planter compared to a cup planter. This is because picks are inserted into individual seed pieces causing a puncture wound. When picks are inserted into a diseased potato, they may become infested with single or multiple pathogens, which are then spread to other non-infected seed pieces.

Cleaning and disinfecting of the picks in conjunction with replacing old and worn picks prior to the beginning of the planting season will help decrease disease spread from one year to the next. Cleaning and disinfection during the current planting season is more difficult. If a seed lot has a pathogen concern—a known disease problem—then cleaning and disinfecting the picks between seed lots is recommended.

Cleaning and disinfecting storage facilities

Storage cleaning and disinfection is important, especially to minimize disease carryover from one season to the next. This is a critical initial step in storage facilities that had tuber breakdown due to rot or “hotspots” where tuber decay had occurred the previous storage season.

Previous research at the University of Idaho showed that silver scurf (caused by the fungus *Helminthosporium solani*) survived on foam insulation and soil floors for at least 9 months and in plywood and sheet metal for 3 months. Bacterial ring rot can survive on hard surfaces for up to 3 years and for up to 7 seven years on wood surfaces. The potential for pest carryover from one storage season to the next makes the following cleaning procedures imperative to all farming operations.

Complete storage cleaning and disinfection consists of the following steps

1) Remove plant debris and foreign material.

Before harvest, prepare the storage facility for receiving potatoes by eliminating foreign material. Clean up trash such as old tubers, duct tape, wood, metal, and insulation inside the storage. After removing all visible foreign material, pass a magnet over the floor to collect remaining metal contaminants. It is equally important to clean trash and debris that may have accumulated in the area directly in front of the storage doors.

2) Remove 1- to 2-inches of dirt floor and replace with non-potato soil.

This step is often difficult to accomplish in a timely manner and one that often can be overlooked. If silver scurf infection is a perennial problem in the storage, or is of great concern, this is an important step to reduce disease spread. Growers who have had bacterial ring rot on their farm should replace the upper layer of soil in their storage facilities as well.



A pressure washer spraying hot water and detergent is a very effective tool for removing soil, dried sap, and other contaminants from storage facilities and equipment. Be aware, however, that pressure washers and even steam cleaners have limitations.

Photo courtesy of Potato Services of Idaho LC

3) Wash the entire facility with soap and hot water or steam, then rinse with water afterwards.

Washing is probably best accomplished with a pressure washer using hot water and detergent. Soap-based detergents are often fairly effective disinfectants in their own right, but are particularly effective at dissolving dried potato sap or other residues that might be adhering to floors, walls, or equipment.

Steam washers can also be extremely effective for equipment cleaning because the high temperatures associated with steam make it very effective in dissolving dried materials. Unfortunately, steam cleaners cannot be relied upon to maintain the extremely high surface temperatures required for thorough disinfection for the length of time needed. For proper disinfection, high surface temperatures must be maintained for several minutes or more.

Walls/duct pipes; beware of biofilms. Remember also that some pressure washers may lack sufficient pressure to reach elevated areas of interior walls, and a ladder may be necessary. Duct pipes must be thoroughly cleaned as well. Simply setting them outside in the sun will not do an adequate job of cleaning. This is because the organisms that cause disease in potatoes are capable of surviving on storage surfaces and on equipment under some fairly harsh conditions. They do so in clumps or films of cells surrounded and protected by dried bacterial slime, dried plant sap, or other materials. These structures are referred to as “biofilms.” Biofilms not only allow some bacterial cells to survive, but can also be very difficult to dissolve and remove.

Exposure to sunlight is a good final step in the cleaning of equipment or duct pipes, after they have been thoroughly washed and disinfected.

4) Apply a disinfectant to all surfaces.

This section also applies to equipment used in potato production and handling systems. A thorough and complete coverage of all surfaces is needed—including plenum, duct pipes, storage bay, and fan house.

Keep disinfectant wet for 10 minutes. There are a number of approved active ingredients, all of which have similar efficacy provided some simple guidelines are followed. Most important is to keep disinfected surfaces wet with the disinfectant solution for at least 10 minutes. This length of exposure has been shown to effectively kill pathogens likely to be on equipment and in the storage facility. Check the label of the disinfectant to see if rinsing is required. Before using any disinfectant be sure that the product is labeled and registered in the state where you are using it.

Selecting storage disinfectant

The following questions may be helpful in the initial selection of a storage disinfectant. Check the label (and supplemental label) for the following:

- Are there any safety concerns or recommended protective gear (PPE)?
- Is the product labeled for porous surfaces and/or non-porous surfaces?
- Is the product labeled for storage facility and/or potato handling equipment?
- Is a final rinse required?

- Is the product labeled for use only on seed potato facilities and equipment?

Role of surface in choosing a disinfectant. An additional question to ask when selecting a suitable disinfectant is what kind of surface materials are to be disinfected.

Porous versus non-porous. A “porous” surface is any permeable surface such as wood, insulation, or dirt floor. In contrast, “non-porous” surfaces are defined as being non-permeable, hard and inanimate, like metal, glass, or concrete.

Calcium and sodium hypochlorites can be corrosive to metal surfaces. In addition, hypochlorites and hydrogen peroxide products are both readily inactivated by organic matter and therefore are not as effective on soil and wood. Soil- and debris-free conditions are vital to obtaining maximum effectiveness with these types of materials.

If using chlorine-based compounds, buffer the solution to a pH of 6.0 to 7.5 for maximum effectiveness. Avoid mixing chlorine compounds with hot water or with other products unless the practice is specifically allowed on the label.

Disinfect for 10 to 15 minutes; close storage for 2 weeks. One of the most important points to follow is to keep surfaces wet with disinfectant solution for a minimum of 10 to 15 minutes. Once this step is complete, close the storage for 2 weeks and open up the doors to air out and dry the storage surfaces. If 2 weeks is not an option, try to allow enough time for surfaces to dry prior to filling the storage with potatoes.

Disinfectant chemistries

The following is a list of common disinfectant chemistries available, but additional products may be available and more appropriate to the surface that needs disinfecting:

- Sodium hypochlorite
- Calcium hypochlorite
- Ammonium hypochlorite
- Chlorine dioxide
- Copper quinolinolate
- Quaternary ammonium
- Hydrogen peroxide and/or peroxyacetic acid mixtures.

This range of chemistries is used in different brands produced by different manufacturers, and there are many variables as to percent of active ingredient, allowable application rates, and whether or not the product is labeled for potato storages and handling

equipment. Professional personnel, such as your storage service provider, can perform all or some of these important steps in preparing for the incoming crop.

Clean storage before storing seed potatoes

Cleaning your storage is also an important step once the crop is removed and prior to storing seed potatoes for cutting and planting. This is especially significant for commercial growers who had previously applied the sprout inhibitor chlorpropham (CIPC) with the potential of residue remaining in the storage.

Mild to severe delays in emergence and growth can occur if seed is exposed to CIPC residues. It is recommended to avoid storing seed in a storage that has been treated with CIPC until one year has lapsed since treatment and the storage structure and ventilation system have been thoroughly cleaned. Always refer to the CIPC product label for specific guidelines and restrictions for subsequent seed storage.

USDA GAP/GHP Audit— good agricultural and handling practices

Many growers are now encouraged to become certified by passing the USDA Good Agricultural Practices (GAP) and Good Handling Practices (GHP) Audit. This audit contains specific questions that refer to the cleanliness and condition of handling equipment and storage facilities.

Many of the audit questions can be properly answered and documented if you are following a cleaning and disinfection program. The GAP and GHP Audit requires documentation that the storage facility and handling equipment are checked and maintained for cleanliness and proper condition. Equipment must be as clean as practical and in good repair. The storage

facilities must be inspected for foreign material, cleaned and maintained in an orderly manner, and the area around the storage kept reasonably free of litter and debris. A proactive effort to exclude pests in and around the storage facility also needs to be documented. An effective cleaning and disinfection program can take care of most, if not all, of these USDA GAP and GHP Audit requirements.

Pesticides

ALWAYS read and follow the instructions printed on the pesticide label. The pesticide recommendations in this UI publication do not substitute for instructions on the label. Pesticide laws and labels change frequently and may have changed since this publication was written. Some pesticides may have been withdrawn or had certain uses prohibited. Use pesticides with care. Do not use a pesticide unless the specific plant, animal, or other application site is specifically listed on the label. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

Trade Names

To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Groundwater

To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

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