Guidelines for Seed Potato Selection, Handling and Planting

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Selecting Seed
Examine Seed for Disease
Prepare to Accept Seed
Disinfect
Seed Handling
Cutting
Planting
Disinfectants Commonly Recommended for Potato Handling Equipment and Storage Facilities

A major limiting factor in profitable potato production is disease, which can be seed-borne, soil-borne, or both. Vegetative propagation can result in the transmission of many yield-limiting diseases caused by fungi, bacteria, viruses and nematodes. Total control of many of these diseases is necessary.

The seed potato industry and associated certification system with visible disease tolerances was formed as one strategy to monitor varietal purity, the process also minimizes disease in seed potatoes by establishing disease tolerances. Planting certified seed is an example, the bacteria that cause ring rot and blackleg can often be present but in a latent condition (that is, not causing outward symptoms). Helminthosporium solani may also be on or in the seed tuber. Viruses are invisible to us and may be present but undetected, impacting on the performance of the seed lot, including the spread and expression of disease in the crop and the resultant quality of the potatoes. Selecting seed, handling and planting of seed lots for the buyer of seed potatoes to help maximize production of a healthy and high-quality crop.

Selecting Seed

Purchase certified seed. You can be assured that such seed conforms to guidelines of varietal purity, field inspections, and disease-free conditions. Ask about the pedigree of the seed; where it originated, how it was produced, what reports, storage inspections and results of winter grow-out tests in Florida, California, or other southern grow-out areas. Pay attention to field inspection reports.

If possible, make a personal visit to seed growers you are considering purchasing seed potatoes from. Note the general appearance of the fields, the condition of the seed tubers, and the storage facilities. Ask if the seed has been treated with Ridomil in the field to protect it from pink rot and leak (water rot). Be aware this disease could be present. Call or write the state certification agency for seed lot records from the past season; the NDSU Lab at NDSU, offer testing services of seed lots for diseases and pathogens for a fee.

Examine Seed for Disease

There are several diseases to watch for and some simple tests to help evaluate seed lots for disease.

Virus Diseases
Certification readings are the best gauges of virus content. Virus symptoms are generally not visible in tubers, except for PVY mosaic. Some varieties, notably Shepody and Russet Norkotah, do not readily express visible mosaic symptoms, and virus can spread for PVY mosaic in these varieties, either in the production or winter grow-out fields. Such tests are routinely used for PV.

**Rhizoctonia**

The black scurf stage on the tubers should not exceed 5% of the tuber surface (Figure 1 – 47KB color photo). Coverage disease is most active in cool soil and causes damage by pinching off the developing sprouts, which must regrow. This is a soil borne disease that requires attention in the field to prevent yield loss.

**Fusarium Dry Rot**

The seed should not have many tubers with symptoms of Fusarium dry rot (Figure 2 – 86KB color photo). A 1 to 2% level is not allowed at shipping. Fusarium inoculum on tubers without dry rot can be determined by cutting 20-30 tubers in half and incubating at 50-60°F in high humidity. Read dry rot after 10-14 days incubation. This test will indicate the potential for Fusarium seed borne disease, many isolates of *Fusarium sambucinum* (synonym = *F. sulphureum*), the agent responsible for dry rot, from throu ght active ingredient in Mertect, resulting in reduced disease control. A modification of this test to determine resistance is to use seed lots known to be infected with dry rot; seed lots with ring rot are not eligible for using without causing symptoms for up to two years, and may be at such a low incidence as to avoid detection during visual inspections. This testing can be done at the Seed Health Testing Lab at NDSU for a fee.

**Bacterial Ring Rot**

Look for external symptoms of cracks in the skin (Figure 3 – 59KB color photo); cut the stem end of suspect tubers for internal confirmation of ring rot discoloration in the vascular ring (disorders may resemble ring rot, squeeze suspect tubers and look for cloudy bacterial ooze from the vascular ring). Do not use seed lots with ring rot. Soft rot should be odor free, mushy and wet but not sticky and stringy. A stand should be odor free, mushy and wet but not sticky and stringy. A stand will not be scored. These tests will indicate the potential for soft rot seed piece decay if conditions are favorable for decay. More than 50% tuber soft rot. If handled properly (see seed handling and planting recommendations), acceptable stands and most important consideration for reducing soft rot in the seed.

**Verticillium and Fusarium**

These two fungal pathogens can cause wilt and early dying. They are easily visible as vascular discoloration in the stem and is not as important as inoculum on the surface of the tuber or in the soil. For the Red River Valley, the amount of *Verticillium* wilt that results in the field. However, tuber borne inoculum does act as a source of *Verticillium* that will contaminate the seed.

**Scab**

This disease, caused by soil borne *Streptomyces*, is soil borne. Infected seed serves to introduce the scab organism into the field. Infection comes from scab in the soil, not the seed tubers. Excessively scabby seed is unattractive (Figure 6 – 54KB color photo) and should have a toothpick prior to wrapping. Soft rot should be odor free, mushy and wet but not sticky and stringy. A stand should not be scored. These tests will indicate the potential for soft rot seed piece decay if conditions are favorable for decay. More than 50% tuber soft rot. If handled properly (see seed handling and planting recommendations), acceptable stands and most important consideration for reducing soft rot in the seed.

**Silver Scurf**

This is primarily a seed-borne disease, although low levels of inoculum may survive in the soil from one season to the next. Most seed lots have some silver scurf, and the disease may not be observed because many silver scurf lesion patches on the skin of the potato, primarily at the stem end (Figure 7 – 48KB color photo). The fungus causing silver scurf resides in the lenticels of the tuber, the number of lesions that results in the field. However, tuber borne inoculum does act as a source of *Verticillium* that will contaminate the seed.

**Late Blight**

Presence of late blight in seed can be serious and lead to epidemics later in the season. Late blight can overwinter in in 33KB color photo), and, if cut about 1/4 inch deep, as granular rust colored areas internally (Figure 9 – 36KB color photo).
act as one source of blight in the field when planted. Greater than 90% of late blight affected seed tubers decay due to that grow can start an epidemic under favorable conditions. Preliminary research has shown that late blight can be spread. Seed treatment fungicides have been shown to reduce this infection. Federal regulations allow 1% late blight at shipping confirmation. Late blight free seed is the best option.

Early Blight

This is a soil-borne disease caused by Alternaria solani and is sometimes found in seed lots. It is not considered a seed emergence problems due to secondary soft rot and dead eyes.

Nematodes

Generally not a serious problem in the Red River Valley. However, certain areas may contain nematodes and more surviving nematodes should not be planted. Planting of nematode infested seed can be the initial source of field infestation which

Pink Rot and Leak

Most seed affected by these diseases, collectively called water rots, usually decays during the storage season and does not survive. Affected seed is watery and has a pink to charcoal black discoloration. Application of fungicides offers excellent control of these diseases.

Prepare to Accept Seed

After you have selected the seed, agreed to a price and scheduled a delivery time, your storage should be prepared to accept your seed will perform. Do not store seed in a storage where sprout inhibitors such as CIPC have been used unless the entire storage is thoroughly cleaned. The seed house must be thoroughly cleaned and disinfected to eliminate carryover of disease causing organisms capable of surviving freezing temperatures. Clean out all major trash (tubers, vines, dirt, broken boxes, old bags, etc.) and dispose of it in a pile (cull pile). A cull pile is a potential source of many diseases (soft rot, ring rot, late blight, viruses). Instead, burn, chop or compost it to destroy them.

Disinfect

After a rough cleanup, thoroughly wash the storage bins, walls and floor with hot soapy water using a high pressure washer. Disinfectants must be in contact with the surface to be disinfested for a minimum of 10 minutes to kill bacteria. A foaming agent such as a wall, for 10 minutes. Table 1 lists disinfectant groups commonly recommended and some of their characteristics. The disinfectants are effective when used properly at the high label rate.

In addition to the disinfectants in the table, live steam can be used to sanitize. The temperature of the steam contacting the surface is colorless steam. Condensed water vapor (clouds) may be at less than the required temperature. Steam must be used properly to be effective. Do not rush steam cleaning. Steam may be for high temperatures and small surface area covered with the steam appliance.

Following any of the disinfection procedures, rinse well with cold or hot water, remove excess water, replace equipment and seed handling procedures in the storage.

Seed Handling

A separate storage or bin(s) should be available for incoming seed. Keep lots separate if possible. When the seed arrives, inspect and tag. Be sure it has not been damaged or frozen in transit. Store the seed in cool (40-42°F), well-ventilated bins at 85-90% relative humidity. Breaks in the tuber skin may act as entry sites for disease. Bruising of the seed during handling is the main factor causing planting damage. Warming of the seed to lower the reducing sugars and give the sprouts a head start on growing. The recommended temperature is 50-55°F for high temperatures and small surface area covered with the steam appliance. Warming time varies depending on cultivar, but avoid excessive sprouts, which can spread disease during growth.
Planting, but in practice this may result in excessive decay from bacterial soft rot and Fusarium dry rot. Precut seed should be for drying and wound healing. This practice is beneficial for cultivars such as Nooksack and Atlantic, which have erratic emergence.

**Cutting**

Use a clean disinfected cutter. Seed cutters with "open cell" sponge rollers that can absorb water can also absorb ring rot bacteria killed by disinfection procedures. Therefore, use of cutters with water impermeable (closed-cell) sponge rollers is recommended of about 2 ounces. Clean and disinfect cutting equipment, preferably each day and definitely between seed lots. This will reduce seed (at least spot check) for disease - especially ring rot. If ring rot is discovered, the seed lot should not be planted. Remove facilities. Provide workers with disinfectants and wash facilities to prevent bacteria from entering the seed cutting area. Dip a pair of rubber boots soaking in disinfectant and change boots when entering the warehouse. Provide workers

**Planting**

The three main points of planting are: 1) get good seed, 2) handle it carefully, and 3) use cultural practices that encourage quality seed potatoes will minimize disease and maximize emergence and stand:

- seed and soil should be the same temperature; 50°F is optimum
- avoid wet, soggy soils
- handle seed gently
- do everything possible to encourage quick emergence
- plant shallow and hill plants as they emerge

Seedpiece decay (SPD) can be a major problem in some years in all production areas. The two major causes of SPD are bacteria capable of causing SPD. *Fusarium* SPD tends to be dry, slow-moving decay whereas *Erwinia* SPD tends to be a wet, fast-moving soil movement. The vascular system of the plant causing wilt and blackleg

*Fusarium* decay in the field is favored by a wide range of temperature and moisture conditions. Because this pathogen needs water, it is best to plant in the fall when the weather is cool and dry. However, if the seed is stored in a warm, humid place, it will continue to decay when planted.

Most seedpiece decay is caused by *Erwinia* bacteria. *Erwinia* seedpiece decay (SPD) is favored by cool, wet weather. The cox which is very sensitive to drying. Excess water also inhibits resistance of the potato to disease. *Erwinia* can enter not only through (breathing pores) of the tuber. When conditions of low oxygen occur in the field (wet soil), the bacteria become active and car from stem cutting programs, contain *Erwinia* bacteria in the lenticels. In a sense, bacterial seedpiece decay is a disease waited for by these pathogens.

There are two important factors that affect SPD: 1) the quality of seed - how clean (disease-free) the seed is, and 2) the environment in which the seed is kept. Some principles, the following planting recommendations have been formulated for control (or at least partial control) of SPD.

Treat the seed with a recommended seedpiece treatment chemical. There are many chemicals available - experience and the use. Do not use thiabendazole compounds (TBZ, thiophanate methyl) as a seed treatment if Merestic has been used on the seed pieces instead of containing captan, thiophanate methyl, mancozeb, bleach and fludioxonil, or mixtures of these compounds. Except for bleach, a pathogen *Fusarium* coeruleum and *sambucinum*, *Helminthsporium solani* and *Rhizoctonia solani*. In recent years, many isolates of *Fusarium* in control blackleg. None of the treatments affect fungi (especially *Fusarium*) already in the seedpiece. They affect only pathogen

The inert ingredients, or carriers, are part of the seed treatments and may play a role in seed treatment performance. Bark can be used instead of mineral carriers such as talc, gypsum or clay. The mineral ingredients may trap water, becoming gummy and cutting off oxygen. Seed treatments are fungicides. None of the treatments will affect lenticel-borne *Erwinia*. However, because *Fusarium* in control blackleg. None of the treatments affect fungi (especially *Fusarium*) already in the seedpiece. They affect only pathogens.

Seed treatments can be used going into storage, at the time seed is removed from storage, or at cutting time. Application time can be determined by the product label. The usual application time is immediately after seed cutting; consult the product label to determine timing of the seed application of seed treatment fungicides, but more work is needed in the area of fungicide application for dust control and control.

Blackleg can be minimized in a seed lot containing up to 50% of the tubers infested with *Erwinia* by bruise avoidance, warming and establishment on their own roots.
If all these recommendations are followed, the seed you bought has a better chance of performing as you think it should. Recommendations should be combined in an integrated approach with the goal of minimizing losses to disease and maximizin

### Table 1. Disinfectants commonly recommended for potato handling equipment

<table>
<thead>
<tr>
<th>Disinfectant</th>
<th>Inactivated by organic matter</th>
<th>Inactivated by hard water</th>
<th>Corrosive to metal</th>
<th>Safety</th>
<th>Recommended concentration for use</th>
<th>Recommended exposure time</th>
<th>Shelf life</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary ammonium compounds</td>
<td>Some</td>
<td>No</td>
<td>Slight</td>
<td>Use caution (see comments)</td>
<td>10 min</td>
<td>1-2 yr</td>
<td>Diluted disinfectant relatively safe, concentrated form is poisonous. Stainless</td>
<td></td>
</tr>
<tr>
<td>Hypochlorites (5.25% bleach)</td>
<td>Yes (except iron)</td>
<td>No</td>
<td>Yes</td>
<td>Irritant, caustic</td>
<td>1:50 (0.1%) or 1:200 (see comments)</td>
<td>10 min</td>
<td>5.25% bleach stable 6 mo. at room temp.</td>
<td>Quick acting, inexpensive; caustic to skin and clothing. Use at 1:50 when mixing with water only. Is more effective at pH 7-8 than at normal pH of 10-11. For maximum effectiveness, use 1 part 5.25% bleach: 200 parts water, 0.6 parts white vinegar. Gives concentration of 256 ppm.</td>
</tr>
<tr>
<td>Iodine compounds Some (except iron)</td>
<td>No</td>
<td>Yes</td>
<td>Relatively safe. Use caution.</td>
<td>Label directions</td>
<td>10 min</td>
<td>1-2 yr</td>
<td>Do not take internally. No longer effective if it loses yellow-brown color. Tamed iodophor compounds work best.</td>
<td></td>
</tr>
<tr>
<td>Phenolic Compounds Some; not greatly</td>
<td>No</td>
<td>No</td>
<td>Oral poison. Use caution.</td>
<td>Label directions</td>
<td>10 min</td>
<td>1-2 yr</td>
<td>Provides residual action. These have name &quot;phenol&quot; on label of ingredients.</td>
<td></td>
</tr>
<tr>
<td>Chlorine Dioxide No</td>
<td>No</td>
<td>No</td>
<td>Non-toxic</td>
<td>Label directions</td>
<td>10 min</td>
<td>2 wks when mixed</td>
<td>Use potentiated form by mixing base + activator. Broad spectrum activity against viruses, fungi, and bacteria; does not produce THM.</td>
<td></td>
</tr>
</tbody>
</table>

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