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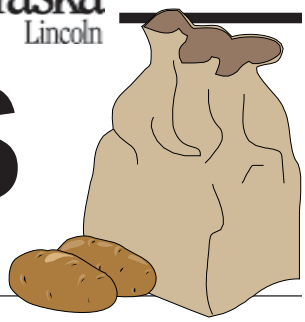
POTATO EYES



Vol. 17, Issue 1, Winter 2005 • Alexander D. Pavlista, Ph.D., Extension Potato Specialist
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Cutting whole tubers for planting

Cutting whole potato tubers and use the pieces for seed ("seed-pieces") is a common practice in North America and Europe.

A key reason for cutting is to produce seed-pieces to recommended planting size. Nearly all harvested potato tubers are over six ounces to achieve high yields. However, another key reason is to overcome apical dominance exerted by the apical eye or sprout. In brief, the apical eye or sprout (at the "bud end") suppresses the sprouting of eyes more basal (toward the "stem end"). For more on apical dominance in seed tubers, see "Physiological Aging of Seed Tubers" in the Spring 2004 issue of Nebraska Potato Eyes (vol. 16, issue 1).

A major problem with cutting, however, is that it opens a severe and large wound through the skin, allowing some key pathogens to get into the seed-piece. Because of this, seed-pieces must be allowed to heal (suberize) and seed treatments containing fungicides are applied.

First, how different is it to plant seed-pieces vs. whole tubers? In a recent five-year study on Russet Burbank at the University of Idaho (Nolte et al., 2003), whole seed ("single drop," "B") and seed-pieces, all weighing two to 2.5 ounces as recommended, were exposed to Fusarium inoculum (the cause of dry rot) before cutting. Some seed-pieces were treated with one of several fungicide dusts right after cutting. Whole tubers and seed-pieces were kept overnight at 64° F before planting. The latter would be referred to as "fresh cut", since wound healing would occur in the soil.

There were significant differences in the amount of seed decay (Fusarium) and stem canker (Rhizoctonia). These are summarized in Figure 1. Whole tubers showed some seed

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Fig. 1 - Whole vs. Cut Tubers: Seed Decay and Stem Canker. (modified from Nolte et al., 2003)

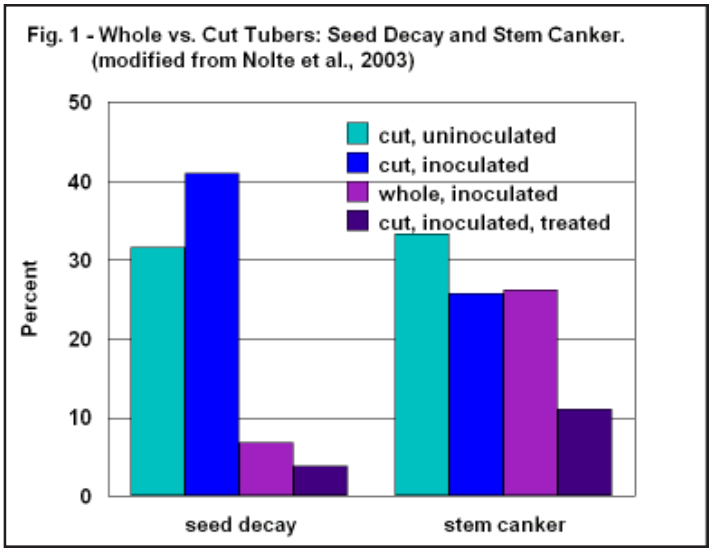
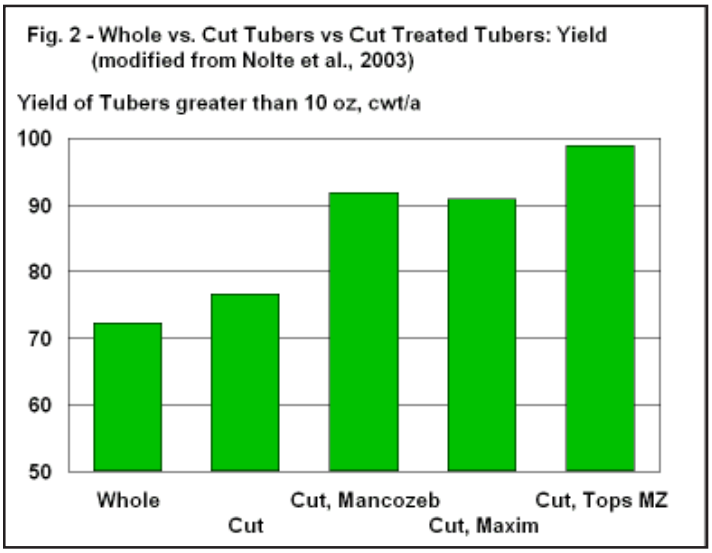


Fig. 2 - Whole vs. Cut Tubers vs Cut Treated Tubers: Yield (modified from Nolte et al., 2003)



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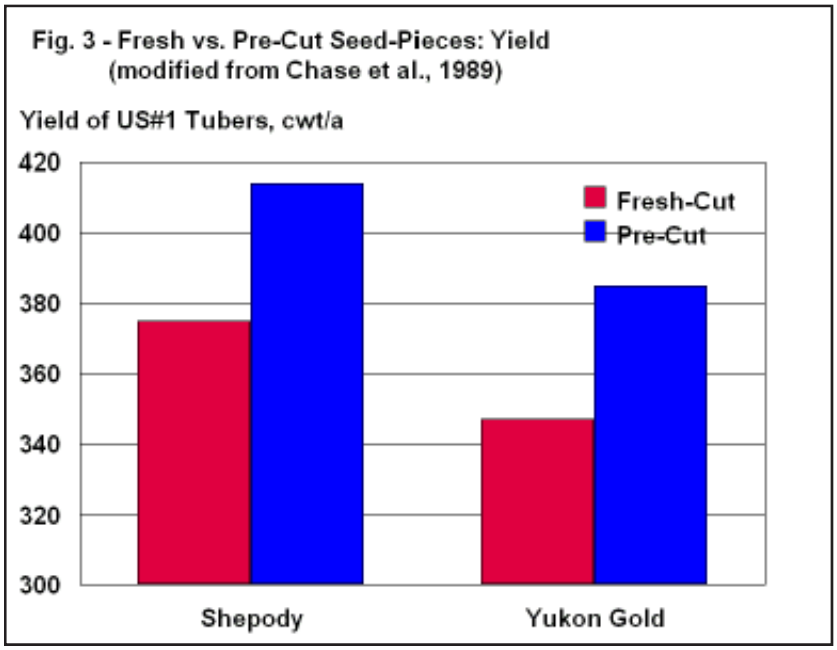
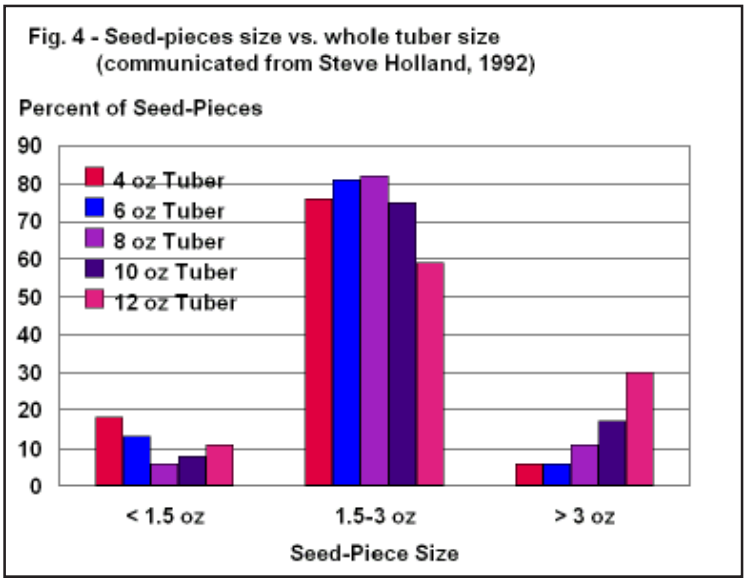
decay, suggesting some bruising during handling. Cutting tubers and treating them with a fungicide dust is better protection against dry rot and stem canker than using whole tubers. [In Fig. 1, the "cut, inoculated, treated" represents average data from inoculated seed-pieces with either mancozeb, Maxim or Tops MZ.] Cutting and treating tubers can improve also yields (Figure 2), further suggesting that treat seed-pieces work best.

Do seed-pieces perform better when healed in storage before planting? Studies at Michigan State University (Chase et al., 1989) suggest that allowing cut seed to heal improved yields of Shepody and Yukon Gold (Figure 3). Fresh cut seed-pieces were planted on the same day as cut and compared to pre-cut seed-pieces which were cut two weeks before planting and stored at 60° F. The yields obtained from pre-cut seed-pieces were 10 percent greater than from fresh-cut ones, and the plants from pre-cut seed-pieces were also reported to emerge earlier, grow vigorously and have a higher stand.

Lastly, how many acceptable seed-pieces would one expect from a whole tuber, and would this vary with size? Figure 4 shows the expected percent of seed-pieces weighing 1.5 to 3 oz cut from whole tubers of varying weights (4-12 oz.). To get the most good seed-pieces with the least waste, cutting tubers weighing about eight ounces was the most effective.





Factors Affecting Wound Healing

When a tuber is cut into seed-pieces, a major wound is formed. This large break in the skin provides a wide-open portal for a host of pathogens to enter and break down potato tissue. The result would be low emergence, poor stand, weak plants, and reduced yield and quality.

To protect itself from these pathogens, a tuber upon being cut or bruised undergoes a healing process referred to as "Wound Healing" or "Tuber Suberization." This process involves the formation of new skin and will be outlined in a later issue of Nebraska Potato Eyes. How can wound healing be promoted? What will delay it?

Several factors affect wound healing. Tuber cutting is the most severe of all wounds and has the greatest exposure to pathogens. Some varieties heal faster, while others form a thicker protective layer. Physiological age of the tuber affects the extent of the healing; younger tubers heal better. The three most important and controllable factors are temperature, relative humidity and aeration. These will be discussed in more detail.

Temperature is the most critical and effective way to promote or delay wound healing. Figure 5 shows this effect. As temperature increases, the speed of suberin formation and wound healing increases – that is, it takes less time for the cut to heal. So if the seed-pieces remain at seed tuber storage temperature, it could take as much as nine weeks to heal. But if warmed to room temperature, this would take no more than one week if other conditions are right.

Relative humidity is the next key factor to wound healing. Figure 6 summarizes data from the UK demonstrating the interaction of relative humidity and temperature. At 50° F, higher humidity promotes suberin formation and periderm, or skin, thickening. Healing at 93% relative humidity gives a distinct advantage over 70%. But at 68° F (room temperature), that distinction disappears. Healing at a humidity above 95% becomes inhibitory, as cell proliferation may occur in addition to the danger of condensation on the cut surface blocking out gas exchange.

The last major factor is air. The two key components are oxygen and carbon dioxide. Too little of the former and too much of the latter delays cell activity. Remember that wound healing is a cell division process and requires metabolism. Figure 7 summarizes this effect with regard to wound healing. Wound healing is best when the air contains at least 10% oxygen (O_2) and preferably there should be less than 1% carbon dioxide (CO_2). Therefore, to promote proper, rapid and healthy healing, the air around seed-pieces must be well ventilated.

Fig. 5 - Temperature Effect on Suberization and Wound Healing (modified from Wiggington, 1974)

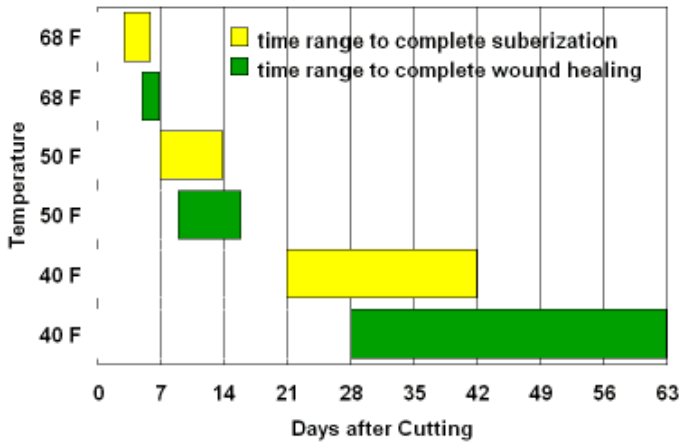


Fig. 6 - Relative Humidity (%) and Wound Healing after One Week (modified from Wiggington, 1974)

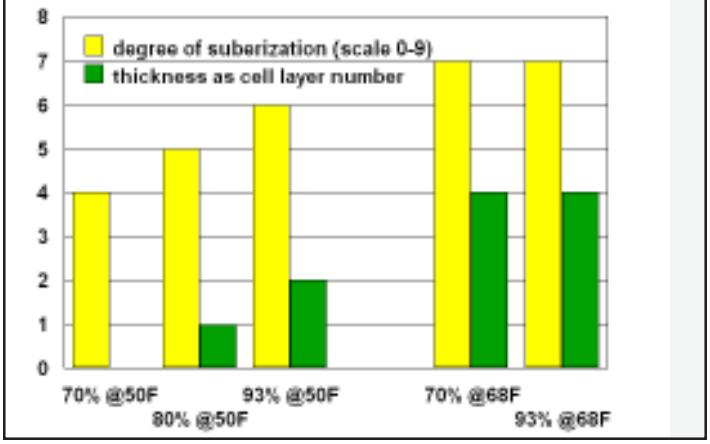
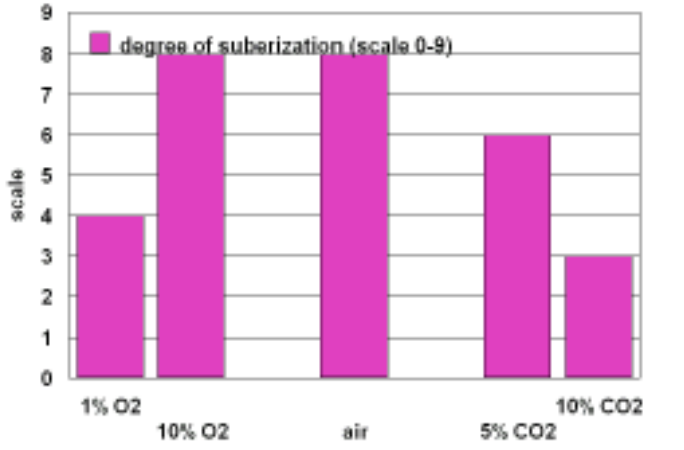


Fig. 7 - Oxygen and Carbon Dioxide, and Wound Healing after three weeks at 50F (modified from Wiggington, 1974)



Handling seed-pieces and planting

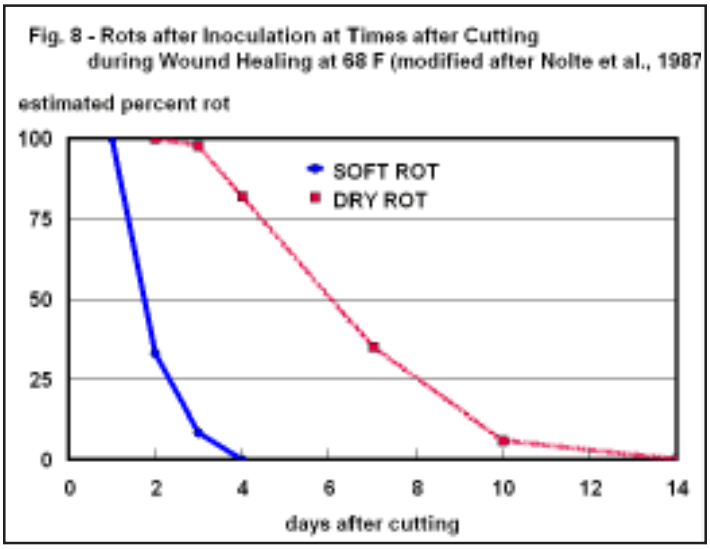
How can a potato producer maximize the chances of success when handling and planting seed-pieces? Research points to the following steps:

Using sharp knives during tuber cutting will improve the healing process, as a smooth surface heals better. Using clean knives will diminish the spread of any tuber rots from seed-piece to seed-piece and minimize the spread of pathogens. It is best to cut tubers that have been warmed for a few days after storage. It is important to heal the cut surface by storing seed-pieces at 55° to 65° F with relative humidity at 85 to 95%. Keep the storage area well-ventilated.

Tubers to be cut should be between six and 10 ounces, and seed-pieces should be two to two-and-a-half ounces with at least one eye. Grade out seed-pieces that are too large and recut them, and grade out "blinds" (pieces with no eyes) and discard them. Do not store seed-pieces in sunlight or expose them to wind, or they will dehydrate.

Use a fungicidal seed treatment after cutting. These treatments have not been reported to delay wound healing, and some (such as mancozeb) may promote it (Nolte et al., 1987). Common seed-treatment products are mancozeb (MZ), Maxim and Maxim MZ, Tops 5 and Tops MZ, Moncoat, and Moncut. They are primarily effective against dry rot, stem canker and black scurf, and silver scurf. For the bacterial diseases, soft rot and common scab, one would need to add streptomycin sulfate as an antibiotic (Dusteret A or LD). For more on these diseases, refer to the book "Compendium of Potato Diseases" and the "Potato Education Guides" web-site.

Allow two weeks for the healing process before planting, one week minimum. Timing is critical. Figure 8 shows the percentage of rot in seed-pieces exposed to Fusarium spp.



(dry rot) and Erwinia spp. (soft rot) at different times after cutting and storing at 68° F (Nolte et al., 1987). After four days, the suberin layer is sufficient to prevent soft rot, while two weeks are needed to prevent dry rot on the seed-pieces. Planting directly into the soil ("fresh cut") will cause the wounds to heal more slowly and increase rot.

Planting should be done at a six-inch depth in soil that is at least 50° F. Cooler soils delay emergence, allowing pathogens time to attack. Plant in soil that is cooler than the seed piece. When the seed-piece is cooler than the soil, moisture in the soil will condense onto the seed-piece. The resulting lack of oxygen (anaerobic conditions) cause slower healing and promote the growth of soft rot bacteria.

It is not advisable to irrigate after planting until emergence. It is better to irrigate prior to planting, so that the soil is about 70% field capacity (see Nebraska Potato Eyes, summer 2003, vol. 15, issue 2). Should the soil become dry and the pre-emergence herbicide needs to be activated by moisture, some irrigation can be applied at two weeks after planting.

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Nolte, P., M. Bertram, M. Bateman, and C.S. McIntosh. 2003. Comparative effects of cut and treated seed tubers vs untreated whole seed tubers on seed decay, Rhizoctonia stem canker, growth, and yield of Russet Burbank potatoes. Amer J Potato Res 80:1-8.

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Book: Compendium of Potato Diseases (2nd Edition). 2001. Eds. Stevenson, W.R., R. Loria, G.D. Franc, and D.P. Weingartner. Publ. APS Press.

World Wide Web -- Potato Education Guides. http// www.panhandle.unl.edu/potato

The Nebraska Potato Eyes is on the WWW at:
www.panhandle.unl.edu/peyes.htm