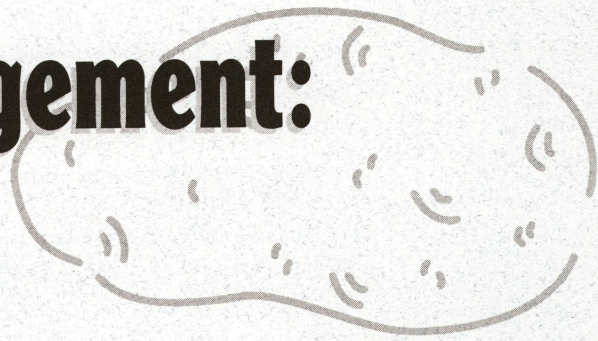


Potato Seed Management: Seed Size and Age



W.H. Bohl, P. Nolte, G.E. Kleinkopf, and M.K. Thornton

Summary

This bulletin addresses two aspects of potato seed management: seed piece size and seed piece age. The impact of seed size and physiological age on seed performance and guidelines for management will be discussed.

Seed Tuber and Seed Piece Size

Seed piece size affects seed performance, which, in turn, is highly dependent on the size of the uncut tuber. For this reason, the proportion of large tubers must be considered when selecting a seed lot. After selection and purchase, it is critical that the tubers are cut into an acceptable seed piece-size range.

Seed tuber size

The size of the cut seed pieces will depend on the size of the uncut tubers. Tubers for cutting should be between 3 and 10 ounces. This size range is important because there are limitations to the numbers and nature of cuts that can be made by a mechanical seed cutter. Tubers larger than 10 ounces should not be used for seed. A 3-ounce tuber that is cut exactly in half would yield two seed pieces in the acceptable size range. However, it is not likely that a seed cutter would cut these tubers exactly in half, so it is recommended that tubers 1.5 to 3 ounces be planted as single-drop seed potatoes.

When cutting tubers larger than 10 ounces, the likelihood of producing more blind seed pieces (those with no buds or "eyes") increases. This occurs because the

number of eyes on each seed tuber increases only slightly as the tuber size increases. This means that the larger the tuber, the fewer eyes there are on a seed piece of the recommended size. Varieties such as Shepody that have few eyes per tuber are especially prone to these seed piece conditions. Large tubers also tend to produce seed pieces that are too large. Seed pieces larger than 3 ounces may not readily flow through the planter, causing skips during planting.

For Russet Burbank, an average of 2.5 to 3.5 stems per plant is considered optimum for maximum performance in commercial plantings. The number of eyes per seed piece influences stem numbers per plant. Every eye on a seed piece or whole tuber has the potential to produce at least one stem, although there are physiological factors that may prevent the eyes from producing a stem. Seed pieces cut from large tubers may not contain enough eyes to produce the desired number of stems per plant.

For seed production, higher stem densities are required to encourage the production of optimum-sized seed tubers. Closer in-row seed piece spacing or a larger seed piece size can be used to increase stem density in seed production operations.

Seed piece size

Seed piece size may influence the performance of a potato crop. Emergence, seedling vigor, subsequent plant growth, and final yield are all related to seed piece size. Research shows that larger seed pieces result in more total yield than smaller sizes. However, the benefit of larger-sized seed pieces diminishes as the size of seed pieces increases above approximately 2.5 ounces (Iritani et al., 1984). The optimum seed piece size depends on factors such as availability and cost of seed, in-row spacing, and market incentives. In

3
322
0.1031

most cases, seed pieces between 1.5 and 2.5 ounces in size will provide optimum returns. Seed pieces less than 1.5 ounces in weight are less productive than larger seed pieces due to the smaller amount of reserves available for sprout growth. Because of the low productivity of small seed pieces, grower returns are increased by reducing the proportion of seed pieces under 1.5 ounces used for planting. Generally, seed pieces more than 3 ounces should be avoided because they increase seed costs and reduce planter accuracy.

Multiple-cut seed pieces may not perform as well as those with only one cut surface or single-drop (uncut) potatoes. Seed piece performance trials at Kimberly show that single-drop seed pieces, when properly handled, perform best. Tubers and seed pieces smaller than 1.5 ounces should be eliminated during sorting and cutting. Researchers at Washington State University calculated that if only 10 percent of the total weight of seed pieces were under 1 ounce, it would result in approximately 20 percent of the planted area having seed pieces with limited yield potential (Thornton, et al., 1986). It has been estimated that planting undersized seed pieces costs growers in Idaho an average yield reduction of 50 to 60 cwt per acre (Vogt, et al., 1973).

Not only is it important to have the correct average seed piece size, it is also important that the majority of seed pieces fall within the 1.5- to 2.5-ounce size range. A seed lot could be cut into seed pieces that fall into an acceptable average size, but not have an acceptable size distribution. For example, a seed lot could, in theory, have equal numbers of only 1 ounce and 3 ounce seed pieces, which is an average seed piece size of 2 ounces. However, the size distribution of this cut seed would be unacceptable because all seed pieces would be either smaller than 1.5 ounces or larger than 2.5 ounces.

Average seed piece size can be easily determined. First, collect and weigh a sample of cut seed pieces and then count the number collected. Next, divide the weight of the seed pieces in ounces by the number of seed pieces to determine the average size.

Determining the seed piece size range takes a little more time. This procedure requires weighing every seed piece individually and placing each seed piece into a size category of under 1.5 ounces, 1.5 to 2 ounces, 2 to 2.5 ounces, etc. This procedure could be simplified by dividing the seed pieces into only three categories: under 1.5 ounces, 1.5 to 2.5 ounces, and more than 2.5 ounces. Next, count the number of seed pieces in each size category. Divide the number of seed pieces in each size category by the total number of seed pieces and multiply by 100. This will give you the percent of seed pieces in each size category.

All cutting operation managers should know both the average seed piece size and the seed piece size distribution of each seed lot being cut. Adjust the cutter as needed to optimize seed piece size and distribution.

Table 1 shows the amount of seed needed per acre depending on the seed piece size and spacing. Amounts in Table 1 are for cut seed, so the actual amount of seed that needs to be purchased should be increased by approximately 10 percent to account for cutting waste and eliminating seed pieces too small for planting.

Table 1. Amount of seed needed to plant one acre of potatoes at within-row spacings from 8 to 13 inches and seed piece sizes from 1.5 to 3.5 ounces in 36-inch rows.

Seed piece size (ounces)	Within-row spacing in 36-inch rows					
	8	9	10	11	12	13
	cwt per acre					
1.5	20.4	18.2	16.3	14.8	13.6	12.6
2.0	27.2	24.2	21.8	19.8	18.2	16.8
2.5	34.0	30.3	27.2	24.7	22.7	20.9
3.0	40.8	36.3	32.7	29.7	27.2	25.1
3.5	47.6	42.4	38.1	34.6	31.8	29.3

Seed Age

The age of potato seed can be defined in two ways: chronological age and physiological age. Chronological age of seed is simply the number of days that have passed since harvest. Physiological age, however, is more difficult to define, but probably has a greater impact on performance than chronological age. Physiological age may be defined as the internal age of the seed resulting from biochemical changes taking place within the tuber. The following sections will discuss the concept of physiological age and its implications.

Performance of physiologically aged seed

Physiologically aged seed, when compared with young seed, usually has more rapid emergence and more stems per hill among other characteristics as listed in Table 2.

Table 2. Characteristics of young vs. old seed.

YOUNG SEED	OLD SEED
Slow emergence	Rapid emergence
Fewer stems per hill	More stems per hill
Low tuber set	Higher tuber set
Longer tuber bulking period	Shorter tuber bulking period
Long tuberization period	Uniform tuber set
Larger tubers at harvest	Smaller tubers at harvest

Factors influencing physiological age of seed

A method for precisely determining physiological seed age has not yet been developed, but there are several contributing factors. Consider these factors when purchasing seed and when planting the crop.

- **Growing conditions of the seed crop.**
Generally, any condition that places the growing seed crop under stress causes physiological aging of the seed. Low moisture, high temperatures, inadequate fertility, frost damage, and disease pressure may all cause stress on the potato plant and consequently age the seed tubers produced.
- **Bruising of seed tubers.**
Bruising increases the respiration rate of the seed tuber, which accelerates the aging process. Minimizing bruising during harvesting and handling aids in the reduction of physiological aging.
- **Seed storage temperature.**
Seed held in storage at a constant 38° to 40°F will likely age slower than seed held at higher temperatures because the respiration rate is at a minimum. Fluctuating storage temperatures have the potential to rapidly age seed and should be avoided.
- **Cutting operation.**
After cutting, respiration rate increases during healing of the cut surface, which increases physiological age. In this respect, the cutting of tubers may have much the same effect as bruising. Smooth cuts, made with sharp seed cutter blades, require less energy and a lower respiration rate for wound healing than cuts made with dull blades.

Estimating physiological seed age

To estimate physiological seed age, the buyer needs to know about the seed growing and harvest conditions, handling procedures, and the storage environment. The more that is known about a particular seed lot, the better its physiological age can be estimated.

On one extreme, seed produced under temperature, moisture or fertility stress, disease pressure, and stored under fluctuating temperatures would probably be physiologically old seed. Conversely, seed produced without any stresses, or disease pressure, and stored under a constant temperature would more than likely be physiologically young seed. Producers should estimate the physiological age of the seed based on those factors discussed above. If the physiological age cannot be estimated, then the seed should be considered as "intermediate" and no adjustments should be made in the seed piece spacing during planting as discussed below.

Management Considerations

Both the size and physiological age of the seed piece influence performance and should be taken into consideration when planting the potato crop. Environmental conditions also need to be considered when determining how to manage physiologically young or old seed.

Storage just prior to planting

Physiologically young seed emerges slower than older seed. Because of this, there is more of a chance for seed piece decay and infection with *Rhizoctonia* stem canker. To hasten emergence, physiologically young seed can be held at a warmer storage temperature (50° F) until two to three eyes per seed piece have just begun to grow before planting.

In contrast, physiologically old seed emerges more rapidly and may even sprout in storage. Hold it at about 38° F until just prior to planting, then warm the seed to 45° F prior to cutting and planting.

Seed piece spacing

Large or physiologically old seed pieces are likely to produce more stems per hill than small or physiologically young seed pieces. Table 3 shows the effects of seed piece spacing on the number of stems per acre from seed pieces of three weights and two physiological ages. Regardless of the seed piece size, physiologically-aged seed generally produces more stems per seed piece than non-aged seed pieces of the same size. As shown in Table 3, the number of stems per acre remains relatively constant by increasing the seed piece spacing even though larger or physiologically older seed pieces produce more stems per seed piece.

If seed is suspected of being physiologically old, consider increasing the seed piece spacing when planting. In addition to increasing seed piece spacing, seed piece size should also be increased to increase plant vigor. This adjustment may help eliminate the disadvantage of too many stems per acre resulting from physiologically older seed (Kleinkopf and Barta, 1991).

Table 3. Effect of seed piece size and physiological age on number of stems per hill and per acre at four spacings.

Treatment	Spacing	Seed cwt/acre	Stems/hill	Stems/acre
2 oz	9 in	24	3.1	60,016
2 oz aged	12 in	18	4.1	59,532
3 oz	12 in	27	3.9	56,628
3 oz aged	15 in	22	5.1	59,160
4 oz	12 in	36	4.2	60,980
4 oz aged	18 in	24	6.2	60,016

Adapted from Kleinkopf and Barta. 1991.

Soil temperature at planting

Physiologically old seed usually emerges quicker than young seed, but warm soil temperatures at planting may negate some of these emergence differences. Warm soil temperatures will most likely hasten sprout development in younger seed while physiologically aged seed has already reached its maximum sprout growth rate. Under these conditions, physiologically old seed will emerge at nearly the same time as younger seed.

Under cool spring conditions, the difference between emergence rate for the two types of seed will be maximized. Younger seed, stored at the same temperature as older seed, will emerge more slowly because the older seed develops sprouts at a faster rate. Rapid emergence is beneficial for reducing the incidence of seed piece decay and *Rhizoctonia* stem canker, but if this rapid emergence is a result of physiologically old seed, the benefits may not be realized.

Seed potato producers have different tuber size and total yield expectations than do commercial growers. The rapid emergence and high stem and tuber production of physiologically aged seed may be beneficial under the short growing season conditions experienced in many seed production areas in Idaho. Under these conditions, use of physiologically aged seed may result in higher production of single-drop seed tubers, and tubers less than 10 ounces that are desired for seed.

Literature cited

- Iritani, W.M. and R.E. Thornton. 1984. Potatoes: Influencing Seed Tuber Behavior. PNW 248. 15 pp.
- Kleinkopf, G.E. and J.L. Barta. 1991. Seed Quality for Commercial and Seed Growers. Proceedings of the Idaho Potato School. 23: 255-257.
- Thornton, R.E., G.M. Hyde, and K. Zhoa. 1986. Addressing the Potato Stand Problems in the West. In: Proceedings of the North American Seed Seminar. National Potato Council, Denver. pgs. 104-123.
- Vogt, G.E., F.H. Jacobs, and R.E. Ohms. 1973. Seed piece size, Key to Maximum Potato Yield and Profit. CIS 207. University of Idaho (out of print).

Additional sources of information:

- Bohl, W.H., P. Nolte, and M.K. Thornton. 1993. Potato Seed Management: Seed Certification and Selection. CIS 974. 4 pp.
- Kleinkopf, G., and R.E. Thornton. 1989. Potato Seed Tuber Quality Factors: Physiological Age and Physical Characteristics. Proceedings of the Idaho Potato School. 21: 205-210.
- Nielson, M., W.M. Iritani, and L.D. Weller. 1986. Factors Influencing Eye Number Per Seed Piece. Proceedings of the Washington State Potato Conference 25: 75-80.
- Preston, D.A. 1986. Potato Seed Piece Size and Spacing Survey in the Red River Valley. Proceedings of the Washington State Potato Conference 25: 9-13.
- Schotzko, R.T., G.M. Hyde, and R.E. Thornton. 1983. The Dollars and Cents of the 1982 Potato Seed Size and Spacing Survey. Proceedings of the Washington State Potato Conference 22: 23-29.
- Whitmore, J.C., R. Clarke and L. Ewing. 1989. Guidelines for Russet Burbank Nuclear Seed Production in Idaho. Extension Bulletin 700. 8 pp.

The authors:

William H. Bohl, Extension Educator-Potatoes, Bingham County Extension Office, Blackfoot. Phillip Nolte, Extension Seed Potato Specialist, Idaho Falls Research and Extension Center, Idaho Falls. Gale E. Kleinkopf, Professor of Plant Science, Kimberly Research and Extension Center, Kimberly. Michael K. Thornton, Extension Potato and Onion Specialist, Parma Research and Extension Center, Parma. Nolte, Kleinkopf and Thornton are in the University of Idaho's Department of Plant, Soil and Entomological Sciences.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, LeRoy D. Luft, Director of Cooperative Extension System, University of Idaho, Moscow, Idaho 83844. The University of Idaho provides equal opportunity in education and employment on the basis of race, color, religion, national origin, age, gender, disability, or status as a Vietnam-era veteran, as required by state and federal laws.

