# EFFECTS OF THE SEASON ON SEED POTATO PHYSIOLOGY AND PERFORMANCE

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## INTRODUCTION

One of the most important physiological factors associated with seed potato performance is physiological age. As a seed tuber ages it tends to have a shorter dormancy period, emerges earlier, produces multiple stems, initiates tubers earlier at a lower leaf area index, produces less vine growth, senesces earlier, and produces more tubers but of smaller size. Yields may or may not be compromised depending on season length and the intended use of the harvested crop. We know that seed tubers physiologically age when exposed to higher temperatures. We also know that both seed-growing conditions and seed storage environment will impact seed physiological age. What we don't yet know is what the total impact of the growing season is on seed physiological age.

The influence of the seed-growing season on seed physiology will be dependent upon several factors. One important factor appears to be the weather, in particular temperature, experienced during the season. Both warm and cool temperatures can influence seed physiology, but the timing of these temperature extremes, whether or not they occur at particularly crucial times during the growth and development of the plant, can greatly magnify how influential they actually are. The length of the season can impact seed physiology as well. The shorter the season, the chronologically younger the seed will be coming out of the field. Cultural practices, soil moisture and plant stress during the seed-growing season are also influential factors on seed physiology. The overall combination of these factors that the seed was exposed to during the growing season will affect the physiological status of the plant and will influence to some extent how the seed will perform when planted the following season.

Seed storage is one way of managing physiological age. The warmer the storage temperatures, the older the seed will become. Also, the longer the seed is in storage, the chronologically older the seed will become. Cultivars respond differently to physiological age and how that age subsequently impacts seed performance. A particular level of physiological age in seed lots may be desirable for one cultivar but sub-optimal for another.

University of Idaho research was established to look at the influence of the seed-growing season on seed sprouting and performance, how cultivars differ, and how seed storage affects physiological age and performance. Some results of that research are summarized in this report.

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## SEED-GROWING SEASON AND SPROUTING

Since temperature appears to have a major influence on seed physiological age, both soil and air temperatures were recorded during the seed-growing season for five cultivars in 1999, 2000, and 2001. The cultivars were 'Russet Burbank,' 'Russet Norkotah,' 'Shepody,' 'Ranger Russet,' and 'Umatilla Russet'. Accumulated soil heat units were calculated for each field in each year (Table 1). Comparing 1999 to 2000, overall heat accumulation was much greater in 2000, especially towards the latter part of the season. Therefore, it appears based solely on accumulation of heat units, the seed tubers in 2000 were physiologically older coming out of the field compared to 1999. Tubers from individual fields were collected and placed into storage at the Kimberly Potato Storage Research Facility. The seed was continuously evaluated for sprouting and dormancy break (80 percent peeping) at 38°F storage temperature. Seed from the 2000 seed-growing season sprouted earlier than seed from 1999 except 'Umatilla' (Table 2). In looking at the days to sprout initiation (10 percent peeping), all cultivars initiated earlier in 2000 compared to 1999. The 'Shepody' seed initiated sprouts 80 days earlier in 2000. This information on earlier dormancy break supports the theory that the seed harvested in 2000 was physiologically older than seed in 1999. Therefore, it appears that the seed-growing conditions, in particular the accumulation of heat units, impacted seed tuber physiology and dormancy break.

## SEED STORAGE, AGE AND PERFORMANCE

Since manipulating seed storage conditions, especially temperature, can alter seed physiological age, the harvested seed was exposed to three storage treatments to produce different levels of seed age. The treatments were to hold seed at (a) 38°F, a more typical seed storage temperature, (b) 38°F and then transferred to 45°F for 30 days, and (c) 38°F then transferred to 60°F for 2 weeks. The latter treatment accumulated the most heat units in storage, therefore had the greatest physiological age. Sprout length and development was assessed prior to planting in both years. Sprout development was much greater when the seed was exposed to 60°F for 2 weeks compared to the other treatments. The 38°F storage had the least sprout development, typically just peeping, at planting. See Figure 1 for an example of the sprouting difference between years and seed storage treatments. The cultivar shown is 'Ranger Russet,' but the relative difference in sprouting was similar for all cultivars. To assess the impact of physiological age of these cultivars, the stored seed was planted to evaluate for performance.

It is desirable to have rapid, uniform plant emergence. Seed quality, including seed physiological age, will play a role in emergence in conjunction with soil conditions at planting. In this study, aging the seed by storing at higher temperatures generally promoted earlier emergence except for 'Ranger Russet' seed. In comparing the rate of emergence between the years, seed emerged quicker in 2001 (2000-grown seed) compared to 2000 (1999-grown seed). Two major factors most likely contributed to this difference: relatively physiologically older seed planted in 2001 and warmer soil temperatures at planting.

There is a general relationship between stem numbers and tuber numbers. An increase in stem numbers often indicates an increase in tuber numbers. Physiologically aged seed generally increases stems per plant. This increased stem number characteristic was observed with seed that was aged at the warmer storage temperatures, except for 'Ranger Russet' seed. Overall, stem numbers were higher in 2001 compared to 2000. One major contributing factor for this would be the relatively older seed that was planted in 2001 due to the previous seed-growing season.

The impact of physiologically aged seed on yield depends upon several variables: end-use and desired size profile, length of growing season, planting dates, favorable or unfavorable growing season, and many others. In two years of this study, there were very few significant differences in yield or size profile between aged or non-aged seed. Yield differences that were observed depended upon cultivar, year, and seed storage. In 2001, aging 'Russet Burbank' seed did increase the yield of tubers les than 4 oz. This production of undersized potatoes is undesirable. Due to the potential increase in this undersized tuber category, avoid aging of 'Russet Burbank,' especially in years where the previous seed-growing season may have promoted greater physiological aged seed. 'Russet Norkotah' yields and tuber size profile were not impacted by seed storage treatments. Although trends were observed for lower yields with aged seed in the year early die was present. It appears from this study that although aging did not significantly impact yield or size distribution of 'Russet Norkotah,' it is best to avoid aging seed due to the potential of yield reduction if harvested early. The impact of seed aging on 'Shepody' differed with year. The benefits of having more advanced physiologically aged 'Shepody' seed may be noticeable in some years and not in others.

'Ranger Russet' did not exhibit typical symptoms of aged seed. There were no significant differences in emergence, stem numbers, vigor or yield between aging treatments in both years (Figure 2). Although sprouting was much more advanced with seed storage aging treatments, it did not impact how the seed performed (Figure 1). The 'Ranger Russet' plots were grown full season, harvested in late September, and therefore it is not known if differences would have been observed if plots were harvested earlier. Results from this two-year study would indicate that aging 'Ranger Russet' seed does not greatly impact seed performance.

In 2000, the 'Umatilla' seed showed no differences in emergence, stem numbers or yield between aging treatments. In contrast, in the 2001 season, aging the seed promoted more rapid emergence, increased stem numbers and caused significantly higher total yield and 6 to 10 oz. yield (Figure 3). Potentially the seed was younger, both chronologically and physiologically, in 2000, and therefore warming the seed did not age the seed enough to affect performance. In 2001, the seed was older coming out of the previous seed-growing season and therefore once aged, did show some effects. Based upon these results, there are benefits to aging 'Umatilla' seed especially since emergence can be hastened by aging.

## INFLUENCE OF 2001-SEED GROWING SEASON

The seed tubers harvested in 2001 are still in storage ready to be planted this season. In looking at the temperatures the seed was exposed to during the 2001 seed-growing season, accumulated heat units differed depending upon cultivar (Table 3). Comparing the 2001 season to the 2000, 'Russet Burbank' and 'Ranger Russet' were exposed to similar heat units, 'Umatilla' and 'Shepody' were exposed to more, and 'Norkotah' was exposed to less. However, there were major differences in the timing of the majority of the heat accumulation. In 2001, warmer temperatures tended to occur earlier in the seed-growing season compared to later in the growing season in 2000. The 2001 seed has not been planted out to observe performance, but observations of sprout development in storage has shown interesting results relative to seed-growing conditions. Table 4 shows the difference in percent of tubers sprouting (peeping) by particular days after harvest between the three years. Sprouting of the 2001-grown seed is not as advanced in sprouting compared to the previous years at the same time after harvest. Although heat unit accumulation was similar in 2000 and 2001 for 'Ranger Russet,' the timing of accumulation differed. In 2000, it was warmer towards the end of the growing season.

In general, the seed-growing season has a substantial impact on seed tuber physiology, dormancy break, how the seed responds to the storage environment, and subsequent performance in the field. There appears to be a relationship between accumulated heat units during the seed-growing season, especially later in the season, and seed physiological age. There is still a great deal of research needed to better identify some of those seed-growing factors influencing seed physiology and performance. The cultivars evaluated in this study varied greatly in their response to physiologically aging, yet responded similarly to seed-growing conditions. This indicates the need to continue in the evaluation of how cultivars respond to seed-growing conditions and storage, and to identify ways to handle the seed based upon end-use of the potatoes.

**Table 1.** Accumulated soil heat units (greater than 32°F) calculated from tuberization to harvest.

| Year | Russet Burbank | Ranger Russet | Umatilla Russet | Shepody | Russet Norkotah |
|---|---|---|---|---|---|
| 1999 | 2409 | 2655 | 2138* | 2619 | 2859 |
| 2000 | 2777 | 2882 | 2782 | 2869 | 3352 |
| 00-99 | +368 | +277 | 2644 | +250 | +493 |

*21 day later planting for Umatilla Russet in 1999.

**Table 2.** Days after harvest to dormancy break (80 percent of tubers peeping) and the differences in days to 80 percent of tubers peeping between 2000 and 1999. Sprout initiation indicates when 10 percent of the seed was peeping and the difference between 2000 and 1999. All observations were made in 38°F storage.

| Year | Russet Burbank | Ranger Russet | Umatilla Russet | Shepody | Russet Norkotah |
|---|---|---|---|---|---|
| 1999 | 188 | 121 | 170 | 184 | 143 |
| 2000 | 175 | 84 | 170 | 145 | 124 |
| 2000-1999 | -13 | -37 | 0 | -39 | -19 |
| Sprout initiation (2000-1999) | -13 | -37 | -20 | -80 | -35 |

**Table 3.** Accumulated soil heat units (greater than 32°F) calculated from tuberization to harvest.

| Year | Russet Burbank | Ranger Russet | Umatilla Russet | Shepody | Norkotah Russet |
|---|---|---|---|---|---|
| 1999 | 2409 | 2655 | 2138 | 2619 | 2859 |
| 2000 | 2777 | 2882 | 2782 | 2869 | 3352 |
| 2001 | 2738 | 2806 | 2988 | 2916 | 2965 |

**Table 4.** The percent of tubers peeping in seed storage at 38°F. DAH = days after harvest.

| Cultivar | DAH | 1999 | 2000 | 2001 |
|---|---|---|---|---|
| | | ***% tubers peeping*** | | |
| Russet Burbank | 117 | 0 | 0 | 0 |
| Ranger Russet | 120 | 80 | 100 | 22 |
| Umatilla Russet | 113 | 0 | 0 | 0 |
| Shepody | 104 | 0 | 30 | 0 |
| Russet Norkotah | 110 | 0 | 63 | 0 |

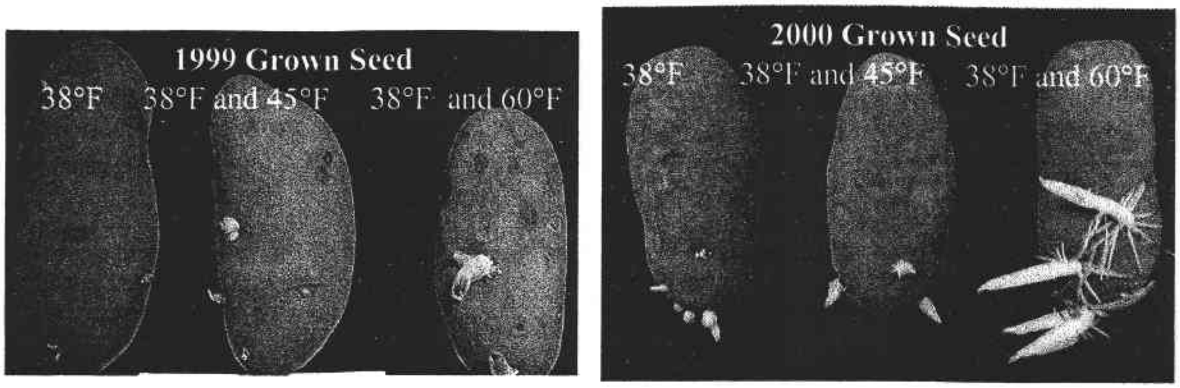


**Figure 1.** Difference in sprouting of 'Ranger Russet' seed at planting between seed storage treatments and years.

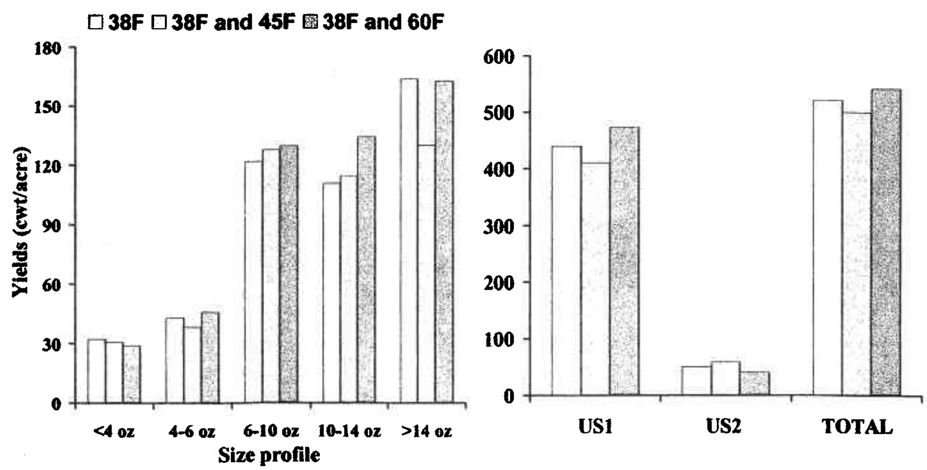


**Figure 2.** Yield (cwt/acre) of 'Ranger Russet' in 2000 as influenced by seed storage treatment.

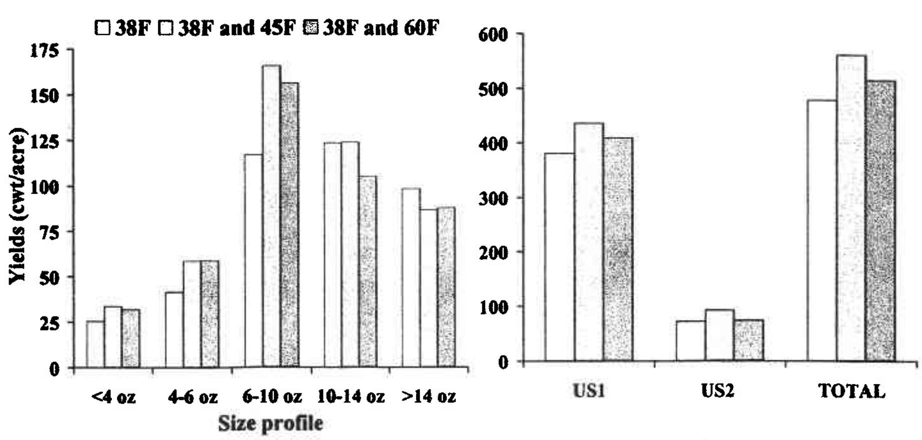


**Figure 3.** Yield (cwt/acre) of 'Umatilla Russet' in 2001 as influenced by seed storage treatment.