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Physiological Age of Seed Potatoes

"The young, the old and the sprout-less"

Seed age can significantly affect the performance of a crop. At any one time the seed tuber has two ages; its chronological age and its physiological age.

Chronological age	This is the tuber age (days, weeks or months) from either tuber initiation or harvest without reference to environmental conditions. Chronological age is more accurate when calculated from tuber initiation as this relates to a fixed point in tuber development. However, determining tuber initiation in practice can be difficult. Measuring chronological age from harvest date is practically a lot easier however less informative as harvest date does not relate to tuber development. Different seed crops with the same harvest date can have different physiological ages, with some seed sprouting and the other remaining dormant.
Physiological age	This is the internal age of the seed resulting from biochemical changes taking place within the tuber. Physiological age can also be defined as the state of the seed tuber which influences it production capacity (Struik 2007). Physiological age depends on both the chronological age and environmental conditions.

Physiological age increases with chronological age. Seed lots with the same physiological age may have different chronological ages and likewise seed lots with the same chronological age may have different physiological ages.

Physiological age of seed will influence how a potato crop will perform (Table 1). Through an appreciation of physiological age of seed lots a grower can choose seed to suit his/her market needs and growing conditions.

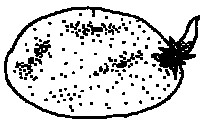
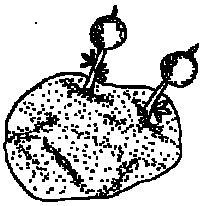
Table 1 Characteristics of young versus old seed

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
More foliar growth	Less foliar growth

Adapted from Adapted from Bohl, Nolte, Kleinkopf and Thorton; Struik (2007)

Stages of physiological age

(Images from Potato Facts: Selecting, Cutting and handling potato seed by S.B, Johnson Bulletin #2412)

	Dormant	• Potatoes do not sprout at all • Dormancy period varies depending on cultivar • Chemical and non chemical means of breaking dormancy
	Young	• Young seed is characterised by apical dominance • Minimal sprouts • Sprouts come of apical end of tuber • Fewer stems per tuber • Fewer tubers but large in size
	Middle aged	• Multiple sprouts • Loss of apical dominance • Multiple stems (eg 3-6) per plant • High number of tubers per plant, but reduced size. • Middle aged seed that has been de-sprouted should be considered old seed
	Old	• Excessive branching of sprouts • Sprouts weak and do not produce vigorous plant • proliferation tubers that plants lack vigour to bulk tubers
	Little tuber disorder	• small tubers form on the sprouts giving rise to the little tuber disorder • This seed age should not be used.

"Middle age is when your age starts to show around your middle" Bob Hope

Potato crops grown from physiological young seed has a longer growing period and therefore high yield potential. Crops grown from seed with an old physiological age will have a shorter growing period and therefore reduced yield potential. Older seed is more suited to regions with a short growing season (restricted by early frost, virus incidence or early markets) in comparison younger seed is suited to regions with a long growing season.

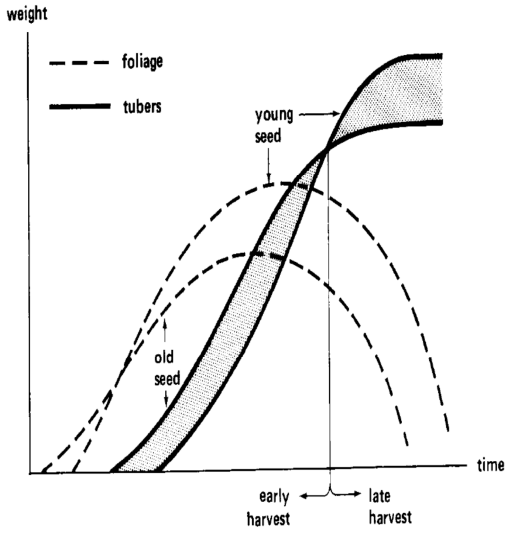


Figure 1 Growth of foliage and tubers from young and old seed; old seed has yields with early harvest v's young seed has yields with late harvest *(Wiersema 1985)*

Crop yield and tuber size is influenced by the number of stems per area and therefore by the number of seed tubers planted and the number of stems per seed tuber. The number of stems per tuber is dependent on the number of eyes, the number of sprouts per eye and the number of stems per sprout. The number of eyes per tuber is cultivar dependant, whereas the other two factors are influenced by physiological age.

The number of stems influences the yield and tuber size of progeny

Aged seed generally produces more stems per set which influences the numbers of progeny tubers set and the size of the progeny tubers. Understanding physiological age of seed will enable potato growers to optimise their management (e.g. planter spacing) to get the best yield and tuber size possible (for a given end-market). Other factors such as planter accuracy, soil fertility, soil temperature at planting and disease will influence the final yield.

With physiological older seed, consider increasing the seed spacing when planting. This can help reduce the drawback of too many stems per hectare from using older seed.

Table 2 shows the effects of seed piece spacing on the number of stems per hectare from seed pieces of 3 weights and two physiological ages. The number of stems per hectare remains relatively constant by increasing the seed spacing of older seed.

Table 2 . Effect of seed piece size and physiological age on number of stems per hill and per hectare with four plant spacings.

		Spacing		Seed tonne/Ha	Stems/hill	Stems/Ha
2 oz	(56.7 g)	9 in	(22.86 cm)	3.01	3.1	148303
2 oz aged	(56.7 g)	12 in	(30.48 cm)	2.26	4.1	147107
3 oz	(84.01 g)	12 in	(30.48 cm)	3.39	3.9	139931
3 oz aged	(84.01 g)	15 in	(38.1 cm)	2.76	5.1	146188
4 oz	(113.4 g)	12 in	(30.48 cm)	4.52	4.2	150685
4 oz aged	(113.4 g)	18 in	(45.72 cm)	3.01	6.2	148303

Adapted from Bohl, Nolte, Kleinkopf and Thorton

Physiological age of seed can influence the incidence of diseases such Rhizoctonia (canker). When young seed is planted in cool soil, emergence is slow increasing the opportunity for sprouts/stems to be attacked by Rhizoctonia.

What factors influence physiological age of seed tubers?

Physiological aging of seed is affected by two factors influencing internal biochemistry of the tubers, especially hormones; genetics and environmental stress.

1) *Potato cultivar*
   Depending on the potato cultivar the period of dormancy may vary from less than a month to several months.

2) *Growing conditions of the seed crop.*
   In general terms, crop stress causes physiological aging of the seed. High temperature particularly towards the end of the growing season, as tubers develop, can significantly increase physiological age of seed produced. Research conducted by the University of Idaho in 1999 and 2000 showed that seed harvested in 2000 was physiological older that seed harvested in 1999 (Olsen and Hornbacher 2002). This was largely attributed to the hotter conditions experienced in 2000, in comparison to the 1999 season conditions. Of five cultivars tested (Umatilla, Shepody, Russet Burbank, Russet Norkotah and Ranger russet) all cultivars initiated sprouts earlier in 2000 than 1999. The shepody cultivar initiated sprouts 80 days earlier in 2000. Given the hot conditions experienced this season in most parts of Australia growers should be aware of the effect these conditions may have had on physiological age of seed and the need to manage potato seed storage to slow aging.

   Other crop stress such as low moisture, inadequate fertility, frost damage, and disease pressure can contributed to the ageing of the seed tubers.

3) *Tuber damage and handling*
   Mechanical damage and bruising increases the respiration rate of the seed tuber, which accelerates the aging process. Therefore, reduced damage and bruising of tubers during harvesting and handling minimises physiological aging.
   De-sprouting tubers advances physiological aging

4) *Seed storage temperature.*
   Higher storage temperatures will speed the aging of tubers. Constant cool storage temperatures (3.3-4.5˚C) reduce the respiration rate of tubers and therefore will reduce the aging of tubers in comparison to material that is stored at high temperatures.
   Fluctuating store temperatures can rapidly age seed and should be avoided.
   Forced ventilation of tubers after harvest can be used to remove field heat, enhance wound healing and slow aging.

A lack of aeration and carbon dioxide build-up can increase the aging process in store.

5) *Cutting seed.*
The respiration rate of cut seed increases during healing of the cut surface, which increases physiological age. Cuts, made with sharp cutter blades, require less energy and a lower respiration rate for wound healing than cuts made with dull blades.

Producing optimal conditions for rapid curing after cutting seed can minimise the impact on seed aging.

How can I tell the age?

There is no hard and fast way of measuring the physiological age of seed. Information about a seed lot in relation to growing and harvest conditions, timing of tuber initiation, handling procedures and storage environment can all be used to better understand the physiological age.

The soil temperature from tuber initiation to harvest can be used to calculate the heat accumulation (day degrees) of a given seed lot.

Collect a sample of seed tubers incubate them in the dark at 15-22˚C and allow them to sprout, compare it with the table at the top if this article.

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