CHANGES IN VIABILITY AND GERMINATION SPEED OF PRIMED SUGAR BEET SEED DURING STORAGE

Rafal Marcinek, Chris Marrow and Stephen Harper*
Germains Seed Technology, Hansa Road, King's Lynn, Norfolk, PE30 4LG, UK

ABSTRACT

It is generally accepted that priming causes some degree of loss of shelf life. Germains priming methods do not cause a reduction in viability after storage for 18 months at 20°C and 55% RH, which is considered to represent 1-year carryover of seed held according to conventional good practice. However, the majority of seedlots suffer some degree of loss in speed expressed as time to 50% germination. This loss is paralleled by non-primed seed, such that the difference in speed between primed and check seed ('advancement') is preserved.

Introduction:

It is accepted knowledge for many species that while priming results in both faster and more uniform germination it causes some degree of loss of shelf life. While there are reports of longevity increased by priming of several species (e.g. Wood & Hay, 2010) the effect on high vigour seed, such as commercial sugar beet seedlots, is generally to reduce shelf life (Varier *et al*. 2010). Development of commercial priming protocols must take account of the shelf life requirement for each individual seedlot and finished product form. For sugar beet, the objective for Germains has been to ensure seed remains suitable for planting if carried over to the following season. In practice, that equates to a period that can extend to 18 months since the commercial priming season typically starts in November while sowing is generally completed by April.

Shelf life is often determined simply as loss of viability, but to varying degrees there is also a progressive loss of germination speed with increasing period of storage. This is of particular significance for primed seed where speed gained through priming is potentially at risk

Storage characteristics of sugar beet seed have not been characterised in detail, but appear to follow common rules that can be applied to all species. On that basis, shelf life is predicted to reduce by half for (1) every 1% increase in moisture and (2) every 10°F (5.6°C) increase in temperature (Bewley & Black, 1994). Hence, to fully characterise changes in sugar beet seed during storage, it is essential to control both temperature and moisture content. We have stored seed under a variety of controlled conditions but experience suggests 20°C at 55% relative humidity (RH) is representative of conventional good storage practice.

* Corresponding author, sharper@germains.com

Materials and Methods:

Samples of pelleted seed were held at 20°C in sealed plastic containers over saturated magnesium nitrate solution to control RH at approximately 55%. Individual samples of 300 seeds were held in plastic trays, as a single layer deep, to ensure every seed was maintained in water activity equilibrium with the headspace.

Germination was tested in paper pleats, with 40 ml water at 15°C. Seeds were scored manually as germinated when at least 1mm of clean white root could be observed. Counts were performed daily at 9am and 5pm until germination had exceeded 50%. The time to 50% germination (T_{50}) was estimated by interpolation between data points. A temperature of 15°C was adopted to slow the progression of germination such that these manual counts could provide reasonably accurate estimates of T_{50}. Advancement of primed seed was expressed as day degrees Celsius (d°C) calculated from the reduction in T_{50} assuming a base temperature of 3°C for germination activity.

Results & Discussion:

Some seedlots do not deteriorate measurably after storage for 18 months at 20°C and 55% RH. But, in Germains experience, laboratory germination tests show that a majority change to some degree. However, there is no evidence from more than 100 seedlots of a reduction in viability.

Since viability is not affected, discussion that follows is restricted to the affect of storage on speed of germination. Tables 1 to 3 present results for 3 representative seedlots that differ in terms of their speed profiles either before or after priming.

Seedlot A (Table 1) shows typical germination speed characteristics, both in unprimed form and in terms of the response to 2 proprietary methods of priming. The speed of primed seed reduces after 18 months of storage, to cause an approximate 5 hour increase in T_{50}. However, unprimed seed also becomes slower after storage. In consequence the difference between unprimed and primed seed, expressed as d°C advancement, does not reduce after storage. Despite the loss of germination speed, primed seed remains substantially faster after storage than the original unprimed check.

Table 2 shows data for a seedlot with faster than average speed of germination before priming. However, response to priming is broadly the same as shown by the more typical seedlot A. Speed decreases after storage but the difference between treatments, expressed as d°C advancement, is not affected significantly.

Seedlot C (Table 3) differs from lots A and B in that the response to XBEET priming is much greater. This might be suspected of setting seedlot C at much greater risk of deterioration during storage. The fear is not supported by data, which shows advancement retained relative to the check after 18 months at 20°C and 55% RH.

References:

Bewley, D. and M. Black. 1994. Seeds: physiology of development and germination. Second Edition. Plenum Press, New York, London. 455 pp.. ISBN 0-306-44747-9.

Varier, A., A. K. Vari and M. Dadlani. 2010. The subcellular basis of seed priming. Current Science, 99: 450-456.

Wood, I.P. and F. R. Hay. 2010. Priming increases the storability and changes the water sorption properties of *Rhododendron griersonianum* seeds. Seed Science and Technology, 38: 682-691.

Table 1. Germination of primed sugar beet seed, **Seedlot A**
Germination in paper pleats at 15ºC with 40 ml water
300 seeds (pellets) sown

Original	**All germ. 72.0 h**	**Germ. (%)**	**Abn. (%)**	**T_{50}† (hrs)**	**Adv.‡ (d°C)**
Check	3.3	95.3	3.0	90.5	-
PAT®	72.0	99.0	0.3	65.8	12.4a
XBEET®	89.3	97.7	1.0	58.0	16.3b
18 months at 20°C / 55% RH	**All germ. 72.5 h**	**Germ. (%)**	**Abn. (%)**	**T_{50}† (hrs)**	**Adv.‡ (d°C)**
Check	0.0	97.0	1.3	100.5	-
PAT®	52.0	97.7	1.3	71.8	14.4a
XBEET®	84.3	97.3	0.7	62.1	19.2b

† Time to 50% germination
‡ Calculated from reduction in T_{50} against check, assuming a 'base' temp. of 3ºC
Values followed by the same letter do not differ significantly (P=0.05 Fisher method)
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Table 2. Germination of primed sugar beet seed, **Seedlot B**
Germination in paper pleats at 15ºC with 40 ml water
300 seeds (pellets) sown

Original	**All germ. 48.0 h**	**Germ. (%)**	**Abn. (%)**	**T_{50}†(hrs)**	**Adv.‡ (d°C)**
Check	0.0	96.7	1.0	77.5	-
PAT®	19.0	97.3	1.3	53.0	12.3a
XBEET®	76.3	97.7	1.3	41.3	18.1b

18 months at 20°C / 55% RH	**All germ. 54.0 h**	**Germ. (%)**	**Abn. (%)**	**T_{50}†(hrs)**	**Adv.‡ (d°C)**
Check	0.0	98.6	0.3	85.7	-
PAT®	16.7	97.7	0.3	62.3	11.7a
XBEET®	69.0	94.7	1.7	50.4	17.7b

† Time to 50% germination
‡ Calculated from reduction in T_{50} against check, assuming a 'base' temp. of 3ºC
Values followed by the same letter do not differ significantly (P=0.05 Fisher method)

Table 3. Germination of primed sugar beet seed, **Seedlot C**
Germination in paper pleats at 15ºC with 40 ml water
300 seeds (pellets) sown

Original	**All germ. 48.0 h**	**Germ. (%)**	**Abn. (%)**	**T_{50}† (hrs)**	**Adv.‡ (d°C)**
Check	0.0	98.3	1.3	96.5	-
PAT	0.0	99.0	0.7	65.9	15.3a
XBEET	65.7	100.0	0.0	42.1	27.2b

18 months at 20°C / 55% RH	**All germ. 48.5 h**	**Germ. (%)**	**Abn. (%)**	**T_{50}† (hrs)**	**Adv.‡ (d°C)**
Check	0.0	99.0	0.3	100.5	-
PAT	0.0	99.7	0.3	74.0	13.3a
XBEET	56.3	99.3	0.0	46.4	27.1b

† Time to 50% germination
‡Calculated from reduction in T_{50} against check, assuming a 'base' temp. of 3ºC
Values followed by the same letter do not differ significantly (P=0.05 Fisher method)