Arab Gulf J. Scient. Res., **15** (1), pp. 149-158 (1997)

Some Effects of Priming on Germination and Vigour of Marrow Seeds and Wheat Grains

Fatima M.M. Al-Ansari

Department of Biology, Faculty of Science,
UAE University, Al-Ain, P.O. Box 17551, United Arab Emirates

ABSTRACT. Seeds with low vigour as a result of ageing showed a large improvement in seed quality following a 40 minutes soak in water in case of marrow, and an 80 minutes soak in water in case of wheat, reflected in increased germination percentage and seedling vigour compared with the non-primed control seeds. These findings may be resulted from the repair of previously sustained deterioration.

The germination process and the consequent establishment of the seedling may actually be enhanced by certain seed pre-treatments (Hurley *et al.* 1989). Naqvi and Hanson (1980) have described a standard pretreatment for improving seed germination. Soaking and subsequent drying back (seed priming) have been shown to have an invigorating effect upon the seeds of a number of species (Woodstock 1988, Sundstrom and Edwards 1989). This treatment can improve the speed of germination (Tesfaye 1992), seedling emergence (Tarquis and Bradford 1992, Sung and Chang 1993), time to reach 50% of final germination (Ellis and Butcher 1988), and field performance (Argerich and Bradford 1989, Bradford *et al.* 1990).

Electron microscope studies suggested that seeds deteriorate during dry storage because damage to membranes, enzyme protein factors and nucleic acid accumulated with time, such degenerative changes result in the complete disorganisation of membranes and cell organelles, allowing the exposure of cell contents to hydrolytic enzymes which increase the damage causing complete failure of germination (Berjak and Villiers 1972).

As far as the author is aware the present study may be considered a pioneer one particularly in the Arabian Peninsula. It is actually an important aspect of seed priming for a country with a hot climate and limited rainfall, *e.g.* U.A.E. It probably presents a rapid establishment of the seedling, with a further possible benefit in increased seedling growth rate.

Materials and Methods

Seeds of marrow (*Cucurbita pepo* L.) of the 1987 harvest were received in sealed aluminum foil bags and kept at 5 °C and grains of wheat (*Triticum aestivum* L.) of the 1989 harvest were received in plain cotton bags. Seeds of both species were obtained from Booker Ltd., Salford Lincolnshire, U.K. Batches of each of these seeds were kept to use as control, other batches were stored experimentally at 35 °C/60% relative humidity, for 9 months and 6 months for marrow and wheat seeds respectively. The seeds were tested to determine their viability.

Total of 2800 grains of wheat were soaked in distilled water for different periods: 5, 10, 20, 40, 80, 160 and 320 minutes at 20 °C. In each treatment 400 grains were used (4 replicates x 100 grains). In case of marrow, 1400 seeds were also soaked in distilled water for the same periods mentioned above at 25 °C (Al-Ansari 1991). In each treatment 200 seeds were used (4 replicates x 50 seeds). All soaked seeds of both plants were then spread as single layers on paper towelling, and dried in the moving air flow of a laboratory fume cupboard at about 23 °C until the original seed weights before soaking, were attained. Seeds were set to germiante directly after drying. Germination percentage, germination speed (hr.), time to 50% of final germination, number and types of abnormal seedling, and seedling lengths and fresh weights were measured and recorded.

Abnormal seedlings of *Cucurbita pepo* were allocated to the following categories (Table 1):

Ia no primary root or well-developed secondary roots.
Ib primary root short and stunted, or short and weak secondary roots.
Ic primary root damages, with weak secondary roots.
VIb short and weak, or watery seedling.

Abnormal seedlings of *Triticum* spp were listed in section 5.8.2 of the 1966 International Rules for Seed Testing (Table 2).

Ia no seminal roots.
IIIe plumule short and thick, usually with short and stunted seminal roots.
Vg completely decayed seedling.
VIa short and weak, or spindly, or watery seedling.
IIIb short leaves extending less than half way up the coleoptile.

Results and Discussion

Results are shown in Tables 1 and 2. Seeds subjected to hydration showed improvements in germination percentage and seedling vigour compared with the non-primed control seeds. A short imbibition period of 40 minutes water soak proved to be the optimum treatment for germination and vigour enhancement for marrow seeds (Table 1), while a period of 80 minutes water soak proved to be the most suitable treatment for the improvement of germination and seedling vigour of wheat grains (Table 2). All tests appeared to correlate well with each other.

Hydration of marrow seeds at 25 °C and wheat grains at 20 °C by soaking in water for different periods of time followed by drying back to their original fresh weights gave an interesting result. The deterioration of the seeds which had been kept at 35 °C/60% RH for 9 months (marrow) and 6 months (wheat) appeared to be partially reversed, and all soaking times employed showed beneficial hydration effect on the improvement of seed viability and seedling vigour.

These results are in agreement with the findings of some authors. Mitra and Basu (1979) showed that soaking-drying treatments produced a beneficial effect on the maintenance of vigour and viability of stored tomato seeds, and Savino *et al.* (1979) found that the pre-soaking treatment favourably affected the maintenance of pea, carrot and tomato seed viability and vigour in storage.

The effect of the period of hydration might be explained by the work of Villiers and Edgcumbe (1975), Chaudhuri and Basu (1988), and Rudrapal and Nakamura (1988), who have shown the viability is very well maintained in fully imbibed seeds probably because in such hydrated seeds the age-induced damage to vital cellular organelles and macromolecules would be able to be enzymatically repaired.

A 40 minutes water soak at 25 °C proved to be the most suitable treatment for improving the performance of marrow seeds, while an 80 minutes water soak at 20 °C proved to be the most suitable treatment for improving wheat grain determination, the lower temperature possibly affecting the rate of repair. Hurley

et al. (1989) showed that a four-hour water soak proved to be the most suitable treatment for improving guayule seed germination.

Ward and Powell (1983) found improvements in onion seed germination after priming and Burgass and Powell (1984) showed that brussel sprouts seeds with low vigour as a result of ageing showed a large improvement in seed quality following 2 hours soaking in water, reflected is an increased germination percentage, rate of germination, and higher emergence in the soil.

We may conclude that soaking-drying treatments of marrow seeds and wheat grains present evidence for a repair or re-invigoration system. This is expressed in the form of improvements in the germination percentage, germination rate, time to reach 50% of final germination, seedling length, seedling growth and fresh weight, and number of abnormal seedlings, as compared to the non-treated seeds. However, full recovery to the level of the control stored seeds did not occur even with the most effective treatment.

Table 1. Effect of pre-soaking on marrow seeds, both stock seeds and after storage at 35 °C/60% R.H. for 9 months, expressed as the mean (± SD) of 10 seedlings, and 4 replicates of 50 seeds for other tests

Treatment time (min)	% Germination	Germination speed (hr.)	T50 (h)	R.I. (mm)	Sh. I. (mm)	Seedling length (mm)	% gain in growth	Seedling fresh wt. (mg)	% and type of abnormal seedlings	
									%	Types
Stock	88 ± 0.4	21.9 ± 0.3	33.4 ± 0.3	129.1	147.0	276.1 ± 6.7	–	1782.3	2.3	2 Ib.
35 °C/60%	68 ± 0.8	18.2 ± 0.3	61.1 ± 2.6	68.4	118.3	186.7 ± 3.0	0	1177.5	11.8	2Ia 3Ib 2Ic 1VIb.
5	69 ± 3.7	18.3 ± 0.3	59.3 ± 2.2	74.4	120.2	194. 6 ± 5.9	4.2	1261.9	11.6	3Ia 3Ib 1Ic 1VIb.
10	70 ± 1.7	18.5 ± 0.4	57.9 ± 1.8	77.1	124.6	210.7 ± 6.9	8.0	1300.6	10.0	2Ia 2Ib 2Ic 1VIb.
20	73 ± 1.1	18.5 ± 0.4	57.3 ± 1.4	94.4	123.2	217.6 ± 6.5	16.6	1387.9	8.2	2Ia 2Ib 2Ic.
40	78 ± 2.2	18.7 ± 0.2	54.9 ± 3.0	106.0	137.3	243.3 ± 5.4	30.3	1584.6	5.1	1Ia 2Ib 1Ic.
80	76 ± 1.8	18.1 ± 0.3	62.5 ± 2.1	87.2	152.1	239.3 ± 5.5	28.2	1354.4	6.6	2Ia 2Ib 1VIb.
160	74 ± 1.4	18.0 ± 0.5	63.0 ± 2.3	81.8	131.9	213.3 ± 3.3	14.5	1290.4	9.5	3Ia 2Ib 1Ic 1VIb.
320	74 ± 2.6	17.9 ± 0.3	63.9 ± 3.1	73.5	117.6	191.1 ± 4.1	2.4	1276.5	12.2	3Ia 2Ib 2Ic 2VIb.

Table 2. Effect of pre-soaking on wheat grains, both stock grains and after storage at 35 °C/60% R.H. for 6 months, expressed as the mean (± SD) of 10 seedlings, and 4 replicates of 100 seeds for other tests

Treatment time (min)	% Germination	Germination speed (hr.)	T50 (h)	R.I. (mm)	Sh. I. (mm)	Seedling length (mm)	% gain in growth	Seedling fresh wt. (mg)	% and type of abnormal seedlings	
									%	Types
Stock	100 ± 0.0	21.0 ± 0.2	24.7 ± 0.1	106.0	126.0	232.0 ± 3.0	–	231.6	1.0	1 Ia.
35 °C/60%	95 ± 1.0	19.8 ± 0.4	37.1 ± 1.2	69. 7	99.5	169.2 ± 4.5	0	161.7	8.4	4Ia 1VIa 2Vg 1IIIb
5	95 ± 1.0	19.8 ± 0.3	36.8 ± 1.8	74.3	96.1	170.4 ± 2.9	0.7	177.3	7.4	4Ia 2 VIa 1Vg.
10	95 ± 0.4	19.9 ± 0.4	36.7 ± 1.1	75.2	101.9	177.1 ± 3.4	4.7	179.2	7.4	4Ia 1VIa 1Vg 1IIIe.
20	96 ± 0.9	20.0 ± 0.4	36.4 ± 1.5	77.1	100.8	177.9 ± 4.3	5.1	182.4	5.2	2Ia 2VIa 1IIIc.
40	97 ± 0.5	20.4 ± 0.5	33.4 ± 1.8	79.6	103.9	183.5 ± 4.5	8.5	191.4	5.2	2VIa.
80	98 ± 0.3	20.8 ± 0.3	29.2 ± 1.0	82.9	102.8	185. 7 ± 5.3	9.8	198.4	3.1	3Ia
160	96 ± 0.9	19.6 ± 0.5	36.9 ± 2.0	75.4	104.0	179.4 ± 3.9	6.0	180.2	4.2	2Ia 1VIa 1Vg.
320	93 ± 0.3	19.4 ± 2.0	39.0 ± 2.0	72.8	101.6	174.4 ± 3.9	3.1	174.0	8.6	3Ia 1VIa 2Vg 2IIIe.

T50 = Time to 50% of final germination; R.I. = Root length; Sh.I. = shoot length.

References

Al-Ansari, F.M. (1991) *Seed Storage and the Climate of the UAE.* Ph.D. Thesis, Department of Biological Sciences, The University of Salford, Salford, U.K.

Argerich, C.A. and **Bradford, K.J.** (1989) The effect of priming and ageing on seed vigour in tomato. *J. of Experimental Botany,* **40:** 599-607.

Berjak, P. and **Villiers, T.A.** (1972) Ageing in plant embryos. II. Age-induced damage and its repair during early germination. *New Phytologist,* **71:** 135-144.

Bradford, K.J., Steiner, J.J. and **Trawatha, S.E.** (1990) Seed priming influence on germination and emergence of pepper seed lots. *Crop Science,* **30:** 718-721.

Burgass, R.W. and **Powell, A.A.** (1984) Evidence for repair processes in the invigoration of seeds by hydration. *Annals of Botany,* **53:** 753-757.

Choudhuri, N. and **Basu, R.N.** (1988) Maintenance of seed vigor and viability of onion (*Allium cepa* L). *Seed Science and Technology,* **16:** 51-61.

Ellis, R.H. and **Butcher, P.D.** (1988) The effect of priming and 'natural' differences in quality amongst onion seed lots on the response of the rate of germination to temperature and the identification of the characteristics under genotypic control. *J. of Experimental Botany,* **39:** 935-950.

Heydecker, W. (1974) Germination of an idea: the priming of seeds. University of Nottingham School of Agriculture, Report 1973-1974 (Part III), 50-67 pp.

Hurley, R.F., Van Standen, J. and **Smith, M.T.** (1989) Guayule (*Parthenium argentatum* Gray) seed germination. The effect of water soaks, sodium hypochlorite, gibberellic acid and gibberellin applied as seed pre-treatments. *SeedScience and Technology,* **17:** 223-233.

ISTA (1966) Proceedings of the International Seed Testing Association, **31:** 1-152.

Mitra, R. and **Basu, R.N.** (1979) Seed treatment for viability, vigour and productivity of tomato. *Scientia Horticulturae,* **11:** 365-369.

Naqvi, H.H. and **Hanson, G.P.** (1980) Recent advances in guayule seed germination. Crop *Science,* **20:** 501-504.

Rudrapal, D. and **Nakamura, S.** (1988) The effect of hydration-dehydration pretreatments on eggplant and radish seed viability and vigour. *SeedScience and Technology,* **16:** 123-130.

Savino, G., Haigh, P.M. and **De Leo, P.** (1979) Effects of presoaking upon seed vigour and viability during storage. *SeedScience and Technology,* **7:** 57-64.

Sundstrom, F.J. and **Edwards, R.L.** (1989) Pepper seed respiration, germination, and seedling development following seed priming. *HortScience,* **24:** 343-345.

Sung, F.J.M. and **Chang, Y.H.** (1993) Biochemical activities associated with priming of sweet corn seeds to improve vigor. *SeedScience and Technology,* **21:** 97-105.

Tarquis, A.M. and **Bradford, K.J.** (1992) Prehydration and priming treatments that advance germination also increase the rate of deterioration of lettuce seeds. *J. of Experimental Botany,* **43:** 307-317.

Tesfaye, M. (1992) The effect of soaking, temperature and other pretreatments on the germination of 'enset' seed. *SeedScience and Technology,* **20:** 533-538.

Villiers, T.A. and **Edgcumbe, D.J.** (1975) On the cause of seed deterioration in dry storage. *Seed*

Science and Technology, **3:** 761-764.

Ward, F.H. and **Powell, A.A.** (1983) Evidence for repair processes in onion seeds during storage at high seed moisture contents. *J. of Experimental Botany,* **34:** 277-282.

Woodstock, L.W. (1988) Seed imbibition: a critical period for successful germination. *J. of Seed Technology,* **12:** 1-15.

(Received 02/04/1996;
in revised form 14/10/1996)

بعض تأثيرات النقع على إنبات وحيوية كل من بذور القرع والقمح

فاطمة محمود الأنصاري

قسم علوم الحياة - كلية العلوم - جامعة الإمارات العربية المتحدة
العين - ص .ب (١٧٥٥١) - الإمارات العربية المتحدة

تحت ظروف مناخية مختلفة تم دراسة تأثير النقع في الماء لبذور القرع والقمح التي عانت من فقدها لبعض حيويتها بسبب تقدمها في العمر الزمني ، وقد تم ذلك بالخطوات التالية :

١- نقع حوالي ٤٠٠ بذرة قرع وكذلك ٤٠٠ بذرة قمح في كأس سعته ٢٥٠ مللتر يحتوي على ماء مقطر ولفترات متفاوته هي ٥ ، ١٠ ، ٢٠ ، ٤٠ ، ٨٠ ، ١٦٠ ، ٣٢٠ دقيقة عند درجة حرارة ٢٥°م بالنسبة لبذور القرع و ٢٠°م بالنسبة لبذور القمح .

٢- نشر البذور المعالجة في صورة طبقة رقيقة على ورق نشاف في مكان متجدد الهواء عند درجة ٢٣°م حتى الحصول على الوزن الذي كانت عليه البذور قبل النقع .

٣- إخضاع البذور غير المعالجة (التجربة الضابطة Control) والبذور المعالجة لمجموعة من التجارب لقياس نسبة الإنبات والحيوية وأوضحت النتائج أن أفضل فترة نقع بالنسبة لبذور القرع كانت ٤٠ دقيقة وأفضل فترة نقع لبذور القمح كانت ٨٠ دقيقة كما يلي :

أ - أزدادت النسبة المئوية للانبات ، وسرعته ، وطول البادرات والوزن الجاف والرطب .

ب- انخفض الزمن المطلوب للوصول لنسبة (٥٠٪) من مجموع البذور النابتة كما انخفضت أيضاً نسبة الإنخفاض في النمو وعدد ونوع البادرات غير السوية مقارنة بنتائج التجربة الضابطة .

يتضح من النتائج السابقة أن البذور التي فقدت بعض حيويتها بسبب عمرها الزمني ولكنها لم تصل لمرحلة الموت فإنه من الممكن أن تسترجع تلك الحيوية بنقعها في ماء مقطر لفترات زمنية متفاوته تختلف بإختلاف أنواع البذور ، وهذه الفترات الزمنية تتأثر بدرجة الحرارة التي تخضع لها المعالجة .