

Effects of Hydration - Dehydration Pretreatment on Vigour and Viability of Rice Seed (*Oryza sativa* L.)

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ABSTRACT. Soaking-drying treatment of rice seeds (*Oryza sativa* L. var. Amber 33) significantly reduced the loss of vigour and viability under accelerated ageing conditions. This was with 12 month seed. The beneficial effects of this pretreatment were associated with significant increase in protease activity, which may reflect a curative effect. Thus, the age-induced damage to the cellular components could be enzymatically repaired. However, similar pretreatment of fresh, 2-month-old seed caused deleterious effect as compared to untreated seeds.

It has been recognised that germination processes and seeding establishment could be enhanced by seed pretreatment (Heydecker 1972). Partial seed soaking and subsequent drying back, has been shown to invigorate and improve the rates of germination and seedling emergence from seeds of a number of species (Henkel 1964, Hegarty 1970, Berrie and Drennan 1971). Hydration-dehydration treatments for controlling physiological deterioration of seeds is a relatively new concept. It has been reported that soaking-drying treatment of stored seeds of a number of crop plants greatly reduces age-induced seed deterioration (Dharmalingam and Basu 1978). Other results assumed that presoaking and drying back of seeds might represent a tool for the improvement of their viability and vigour in storage (Savino *et al.* 1979). However, it has been observed that hydration-dehydration treatment is beneficial to the old seed but detrimental to the fresh seed (Basu and Pal 1979). Therefore, the present investigation aimed to study the effectiveness of soaking-drying pretreatment on viability and vigour of fresh,

2-month-old and 12-month-old rice seeds (*Oryza sativa* L. var. Amber 33).

Materials and Methods

Two-month-old and 12-month-old seeds of rice (*Oryza sativa* L. var. Amber 33) were obtained from Seed Processing Factory in Ghamas, Najef Province. Both seed lots were stored in gunny bags under ambient conditions till treatment.

Soaking-drying treatment was accomplished following the procedure of Basu and Pal (1980).

Seed vigour was assessed by employing an accelerated ageing technique at 100% relative humidity and 40°C (Basu and Pal 1979). Subsamples were withdrawn at 10 days interval for a period of 30 days, and tested for germination and seedling growth parameters.

Seed viability was assessed in germination test recommended by ISTA. Final germination percentage calculated on the basis of 4 replicates of 50 seeds each per treatment, was recorded 96 hr after sowing, and 20 seedlings of each treatment were used to measure shoot-root length. All germination and seedling growth data are averages of triplicate sets.

Batches of seeds were analysed, before and after soaking, and after drying back for protease activity (Cruz *et al.* 1970).

Results

Germination percentages of both lots of rice seeds were not affected after soaking-drying treatment, and before subjecting them to accelerated ageing process.

Viability of 12-month-old seeds was consistently reduced with accelerated ageing time (Fig. 1A). It is clear that these seeds had lost about 50% and 70% of their initial viability after 10 and 20 days of accelerated ageing, respectively. However, subjecting these seeds to soaking-drying treatment before accelerated ageing caused significant improvement in their viability and vigour throughout the ageing process, as revealed by the significant increase in germination percentages at 10 days ($P < 0.001$) and 20 days ($P < 0.05$) of accelerated ageing. Ageing for 30 days showed very low levels of viability in both treated and untreated seeds.

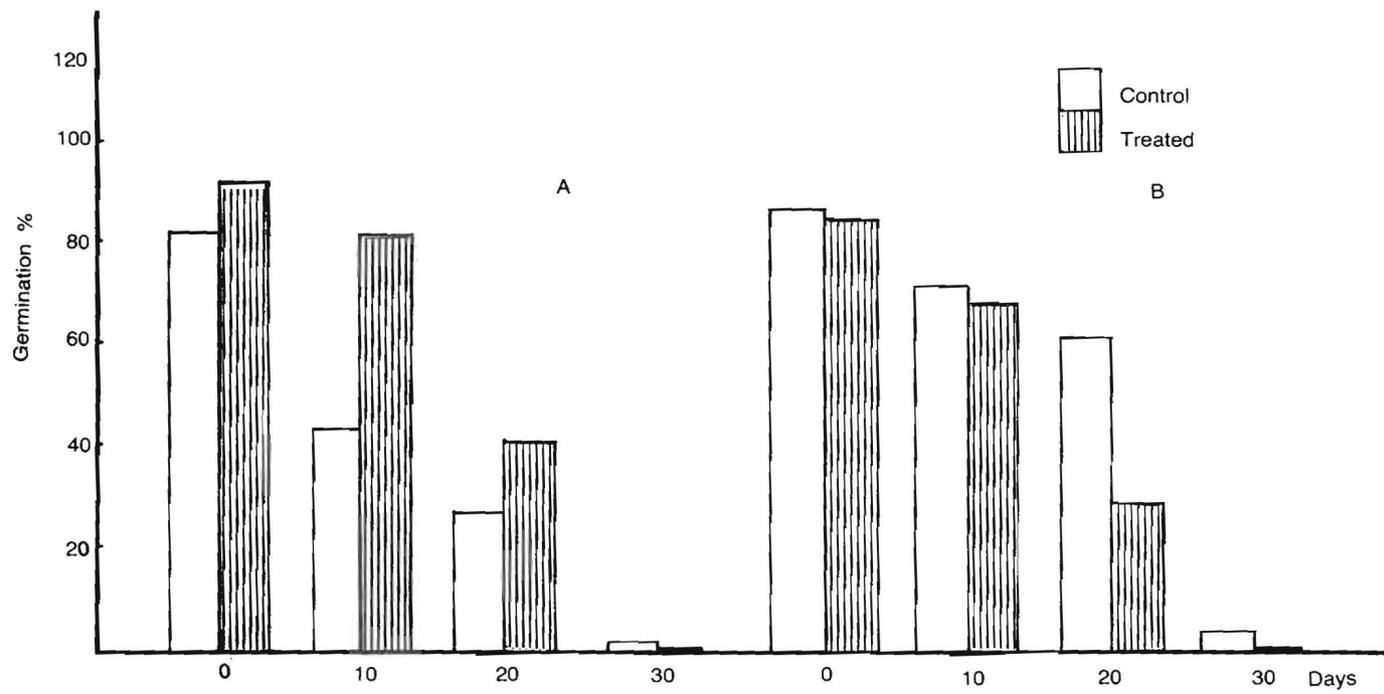


Fig. 1. Effect of soaking-drying treatment on germinability of 12-month-old (A) and 2-month-old (B) rice seeds before and after accelerated ageing for various durations.

On the contrary, the deterioration in germination percentages with ageing process was increased in both treated and untreated 2-month-old seeds (Fig. 1B). In fact, at 20 days interval of ageing, soaked-dried treated seeds showed significant ($P < 0.001$) reduction in germination percentage as compared with untreated seeds.

In general, soaking-drying pretreatment produced comparable significant positive effects in the shoot-root length of both rice seed lots throughout the accelerated ageing process (Fig. 2). Moreover, treatment of 12-month-old seeds produced significantly ($P < 0.001$) greater shoot-root length than untreated seeds before accelerated ageing. This increase was also significant after 10 and 20 days of accelerated ageing ($P < 0.05$, $P < 0.001$, respectively). In 2-month-old seeds, soaking-drying treatment caused significant increase in shoot-root length as compared to untreated seeds at 10 days ($P < 0.001$) and 20 days ($P < 0.05$) of accelerated ageing.

Protease activity of both rice seed lots are shown in Table 1. Soaking of 12-month-old seeds caused a significant increase in protease activity over the control. Most of this increased activity was retained after dehydration treatment. However, protease activity was only slightly increased over the control after soaking of 2-month-old seeds and was not retained after drying back of seeds.

Discussion

It is evident from the present results that soaking-drying treatment has an ameliorating effect upon the viability and vigour of old rice seeds (var. Amber 33). However, this treatment has an injurious effect on fresh seeds. These results are in accordance with that reported by Basu and Pal (1980), and could be attributed to the ultrastructural damage of the cellular membranes as a consequence of rapid water uptake (Parrish and Leopold 1977). This phenomenon has been further supported by the conclusion of Basu and Pal (1980) that the intact cellular membranes of the fresh seed offered greater resistance to the rapid entry of water into the cells of fully immersed seeds, hence suffered greater damage than the relatively leaky membranes of older seeds.

Our results support the view that the beneficial effects of soaking-drying treatment could be the result of repairing mechanisms operating during the first phase of presoaking, which may compensate for a portion of the accumulated damage and restore the seed viability and vigour (Villiers 1973 and Savino *et al.* 1979). Therefore, the observed high protease activity in soaked 12-month-old

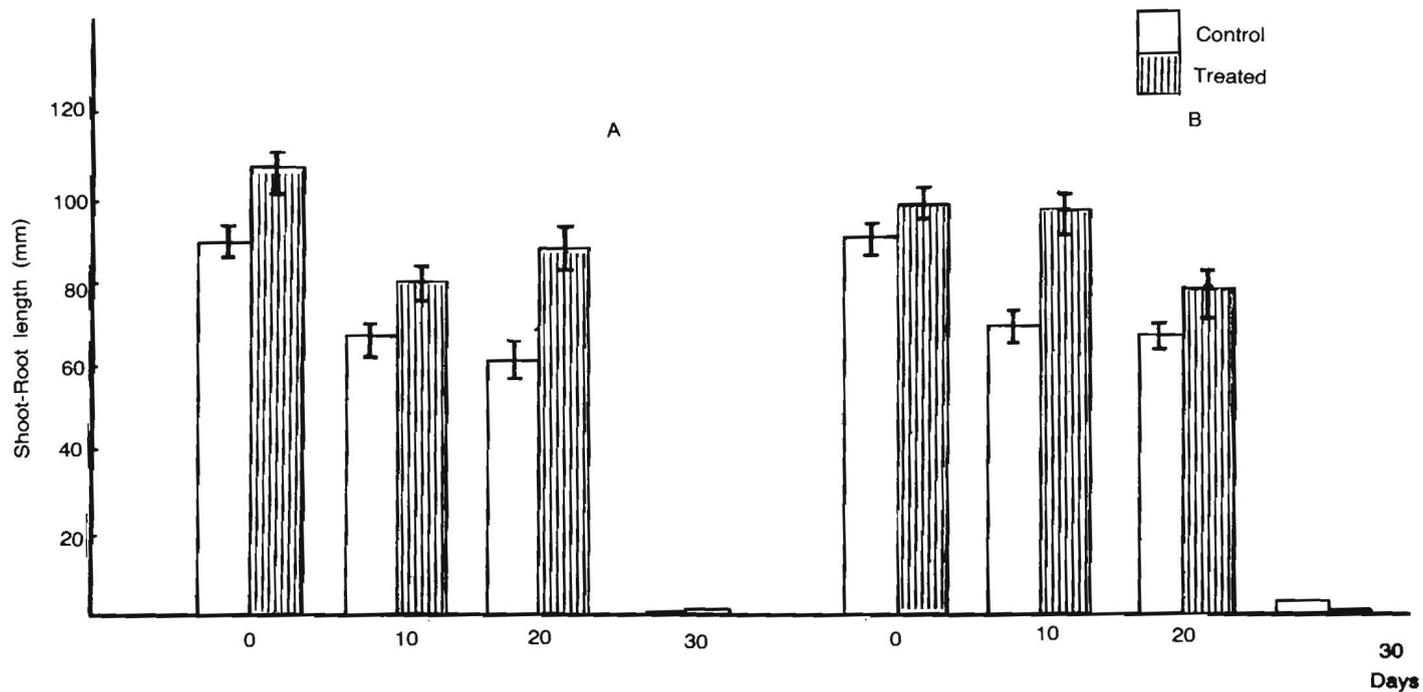


Fig. 2. Effect of soaking-drying treatment on seedling growth of 12-month-old (A) and 2-month-old (B) rice seeds before and after accelerated ageing for various durations. The bars indicated the standard errors.

Table 1. Effect of soaking and soaking-drying treatments on protease activity (enzyme unit/g) of 12-month-old and 2-month-old rice seeds

Seed Age	Protease Activity				
	Control	Soaked seed	Relative increase	Soaked-dried seed	Relative increase
12-month-old	0.17	0.29	69.9	0.27	57.2
2-month-old	0.25	0.28	12.8	0.26	2.4

seeds might reflect the importance of first repair prerequisite for the second phase characterised by DNA synthesis and subsequent cell division (*i.e.* germination). This first phase may be stopped by dehydration without causing embryo damage, since the induced metabolic changes retained in seed upon drying (Dell'Aquila *et al.* 1977). Berrie and Drennan (1971) reported a similar trend of increased protease activity upon hydration and retention upon dehydration in oat seeds. However, the lower degree of improvement in protease activity in fresh seeds might support the fact that the extend of repair mechanisms is usually relative to the initial degree of storage-induced damage to the seeds (Ward and Powell 1983).

The present results are of significant value to the programme of improving the seed quality of important and most prominent Iraqi variety of rice, Amber 33, since this treatment would be most profitable where the value of the seed is high.

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تأثير معاملة التنقيح - التجفيف على حيوية وقوة بذور الرز

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يهدف هذا البحث إلى دراسة تأثير معاملة التنقيح - التجفيف على حيوية وقوة بذور الرز.

فمن المسلم به أنه يمكن تحسين صفات ونوعية البذور باستخدام طريقة معاملة التنقيح - التجفيف على البذور، ولذلك فقد قمنا في هذا البحث بمعاملة بذور الرز (الصنف عنبر ٣٣) وذلك بالتنقيح - التجفيف، ووجدنا أن معاملة هذه البذور باستخدام التنقيح - التجفيف قد خفّضت معنوياً درجة فقدان الحيوية والقوة فيها وذلك تحت ظروف تأثير الشيخوخة، وكانت بذور الرز المدروسة بذور مخزونة بعمر اثني عشر شهراً.

وُجد بعد ذلك أن التأثيرات المحسّنة لهذه المعاملة قد رافقتها زيادة معنوية في فعالية أنزيم البروتيز بعد مرحلة التنقيح، وبقيت هذه الزيادة المعنوية في فعالية أنزيم البروتيز على نفس المستوى بعد مرحلة التجفيف.

وبيننا بذلك أن معاملة التنقيح - التجفيف لبذور الرز المخزونة وبعمر إثني عشر شهراً لها تأثير علاجي. بمعنى آخر، فإنه يمكن إصلاح الأضرار التي يُحدثها تعميمير المكّونات الخلوية بفعل الأنزيمات.

وبين البحث من جهة أخرى أن معاملة التنقيع - التجفيف المماثلة تماماً والتي أُجريت على بذور الرّز الحديثة بعمر شهرين فقط قد أدت إلى حدوث تدهورٍ في هذه البذور بالمقارنة بنفس النوعية من البذور غير المعاملة .

وهكذا نرى أن لهذا البحث قيمة اقتصادية، فهو يعطينا الفترة الزمنية التي نستطيع بها استخدام طريقة معاملة التنقيع - التجفيف وهذا يفيد طبعاً في معرفة الفترة الزمنية المجدية لتخزين بذور الرّز (الصنف عنبر ٣٣) .