

Research Note

Desiccation tolerance and storability of *Mangifera persiciformis* Wu et Ming seeds, a narrowly distributed and endemic species in China

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Summary

Freshly harvested mature seeds of peach-formed mango (*Mangifera persiciformis* Wu et Ming) were used in the present study to obtain information on seed morphological characteristics, desiccation tolerance and storability based on responses of viability to rapid drying and slow drying and storage temperature. In the rapid drying treatments, the seed moisture content was reduced from an initial 32.4% to 18.2% with seed viability decreasing gradually from 100% to 53.2%. When further dried down to 13.7% moisture content, seed viability was rapidly lost. During slow desiccation, moisture content resulting in 50% viability loss was 21.5%, and peach-formed mango seeds with the moisture content of 18.3% exhibited almost no germination. Slow dehydration to about 26.1% water content could not allow for low temperature storage (i.e. 4 and -18°C) at all. Based on the above results, we concluded that peach-formed mango seeds are recalcitrant and short-lived. Such information may be helpful for improving seed performance during storage and for subsequent use in breeding programs. In addition, seed size, weight and seed coat ratio (SCR) were also estimated in order to better understand characteristics of peach-formed mango seeds.

Experimental and discussion

Three categories of seed storage behaviour are generally recognized among plants: orthodox, intermediate and recalcitrant (Roberts, 1973; Ellis *et al.*, 1990). Recalcitrant seeds, such as *Mangifera indica* L. (Corbineau *et al.*, 1986), are characteristically shed from the mother plant with a high moisture content and thereafter remain sensitive to

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desiccation, losing viability as they lose water. Consequently, recalcitrant seeds have been named desiccation-sensitive. Since desiccation-sensitive seeds cannot be dried, storage is only possible for short periods of time and they therefore pose a significant challenge for *ex situ* conservation through seed-gene bank.

A catalogue of recalcitrant species is not finalized. With more extensive study, some other species must be classified as recalcitrant and short-lived. Recently, we have preliminarily investigated the desiccation and storability of peach-formed mango (*Mangifera persiciformis* C. L. Wu et T.L. Ming) seeds. In China, peach-formed mango is an endemic species and is distributed only in the southwestern Guangxi autonomous region Wangmo county in southern Guizhou province and Funing county in southeastern Yunnan province (Wu, 1979). Peach-formed mango is a fruit tree, growing to 30 m of height, which is important for the well being of the populations in the region as a source of household income. However, deforestation is seriously damaging the habitat and biodiversity of peach-formed mango. The success of endemic tree species planting programs largely depends on the availability of good quality seeds from which to produce saplings. Hence, identifying seed storage behaviour is significant for conservation and use of this species.

Mature fruits (each containing one seed) of peach-formed mango were collected at random at the edge of semi-deciduous tropical forest in Napo county in Guangxi autonomous region (23°09'.157' N, 105°52.833' E, 466 m alt.). Seeds were extracted from the fruits, washed and cleaned. The records taken were 1000 seed weight, their dimension (length×breadth) of 100 seeds, ratio of endocarp and testa mass to dispersal unit mass, i.e. 'seed' coat ratio (SCR) (Pritchard *et al.*, 2004; Daws *et al.*, 2006) and the initial moisture content on a fresh weight basis determined by the oven method at 103°C for 17 hours (ISTA, 1999).

For rapid drying, cleaned seeds were buried in newly-regenerated- silica gel at room temperature. For slow drying, cleaned seeds were air-dried to various moisture contents at room temperature (20±3°C) and 50-60% relative humidity (RH). After each time interval (0, 12, 24, 48, 72 and 96 hours and 0, 2, 7, 10 and 14 days for the rapid and slow drying, respectively) 110 unless otherwise stated removed for experimentation. The moisture content of 10 seeds was determined by the oven method at 103°C for 17 hours (ISTA, 1999). The remaining seeds were used for immediate germination with four replications of 25 seeds each. Additionally, to determine the storability, after 2 days for slow drying, one hundred seeds taken were hermetically put in a refrigerator for 7 days at 4°C and another one hundred seeds were hermetically stored in a freezer at -18°C for 24 hours.

Viability was estimated by testing samples of 100 seeds for germination. Each replicate of 25 seeds was tested for ability to germination on filter paper moistened by Mini-Q water in a Petri dish of 12-cm diameter placed in a growth incubator (HPG-280B Illuminating Incubator; Har'erbin Electronic Apparatus Manufactory, Har'erbin, China). Photosynthetic photo flux density (PPFD) inside growth chambers was ca. 40µmol s⁻¹ m⁻² (LI-COR, Inc., Nebraska, USA). Seeds stored at 4 or -18°C were tested for ability to germinate as such. Germination (radicle protrusion) was checked daily for 40 days at a constant temperature of 30°C, and results were expressed as mean values of four replications with standard deviation.

Peach-formed mango seeds are inside thick firm fibroid endocarp with a skin-deep irregular groove, which is ovate or rhomboid-ovate compressed. A peach-formed mango seed with thick testa can easily absorb water (data not shown). Freshly harvested mature seeds exhibited ca.100% germination. Responses of peach-formed mango seeds to drying rate were different. Loss of viability of *M. persiciformis* seeds was faster during slow drying than that of rapid drying (figure 1, figure 2). In the rapid drying treatments, the seed moisture was reduced to 24.7% by 24 hours, and 94% of seeds germinated. However, seed viability decreased gradually to 53.2% when dried down to 18.2% moisture content

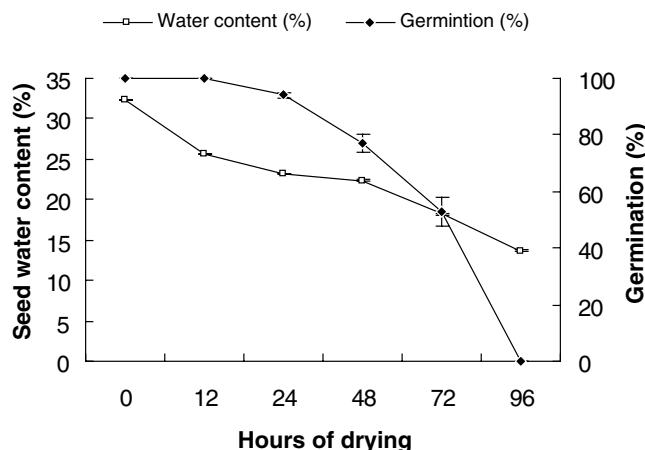


Figure 1. Changes in moisture content and germination percentage of *Mangifera persiciformis* seeds during rapid drying.

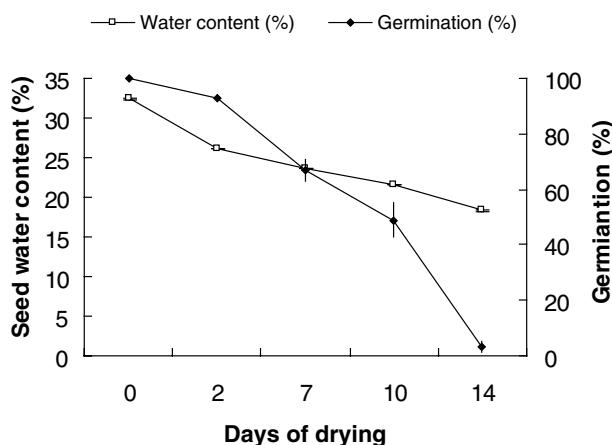


Figure 2. Changes in moisture content and germination percentage of *Mangifera persiciformis* seeds during slow drying.

and then sharply decreased with further desiccation. The moisture content of non-viable seeds dried for 96 hours was 13.7% (figure 1). In comparison, during the slow drying, loss of viability was faster. Moreover, the moisture content resulting in 50% viability loss was higher in slow than fast dried seeds (ca. 24% versus 20%).

As was mentioned above, after 2-day slow drying, the seed moisture content was 26.1% and their viability was 93%. After 7 days storage at 4°C the final germination percentage of peach-formed mango seeds was only 41%. Moreover, peach-formed mango seeds of high moisture content were completely killed after they were stored for 48 hours at -18°C. Thus, desiccation tolerance and storability tests confirm that peach-formed seeds are recalcitrant and short-lived.

The 1000-seed weight was about 8,611 g, which is much heavier than for average orthodox seeds. Besides being heavy the seeds are large, measuring from 26.4×23.3 mm to 40.1×29.0 mm (mean value of 3.64×2.61 mm). The mean SCR of peach-formed mango seeds was 0.39. Hong and Ellis (1996) believed that seeds of the 1000-seed weight exceeding 1,300 g are probably recalcitrant. Also, Chin *et al.* (1984) showed that in general, the recalcitrant seeds are much heavier with their 1000-seed weight often exceeding 500g while Daws *et al.* (2005) showed that the average 1000-seed weight for recalcitrant seeds from semideciduous tropical forests was 3,383 g. Therefore, the seed mass of peach-formed mango is consistent with their apparent recalcitrant behaviour.

In addition, Daws *et al.* (2006) reported that both seed mass and SCR correlate with seed response to desiccation, suggesting that desiccation-sensitive seeds are large and have thin seed coats (low SCR). In the study of Daws *et al.* (2006), SCR of all desiccation-sensitive species is between 0.013 and 0.525. In the present study, SCR of peach-formed mango seed is 0.39, which is in the range of 0.013~0.525. Assuming a seed dry mass of 8.611 g and a SCR of 0.39, the probability of seeds of this species exhibiting recalcitrant storage behaviour is 0.801 according to the predictive model of Daws *et al.* (2006). Consequently seed traits of this species are consistent with its response to drying and reinforce the potential value of the model of Daws *et al.* (2006). Consequently seed traits of this species are consistent with its response to drying and reinforce the potential value of the model of Daws *et al.* (2006) as a screening tool for material of unknown storage behaviour. Assuming a seed dry mass of 8.611 g and a SCR of 0.39, the probability of seeds of this species exhibiting recalcitrant storage behaviour is 0.801 according to the predictive model of Daws *et al.* (2006). Consequently seed traits of this species are consistent with its response to drying and reinforce the potential value of the model of Daws *et al.* (2006) as a screening tool for material of unknown storage behaviour. Assuming a seed dry mass of 8.611 g and a SCR of 0.39, the probability of seeds of this species exhibiting recalcitrant storage behaviour is 0.801 according to the predictive model of Daws *et al.* (2006).

Furthermore, Chin (1984) showed that in terms of moisture content of recalcitrant seeds, the common range is around 40%~60%. Similarly, Daws *et al.* (2006) reported that the desiccation-sensitive species in their study had moisture contents in the range 20.3-52.5%. In the current study, peach-formed mango seeds were shed at 32.4% moisture content.

In conclusion, *M. persiciformis* seeds are desiccation-sensitive and short-lived; consequently alternative storage methods such as cryo-preservation may need to be explored for storing germplasm of this species.

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