Germination, Genetics, and Growth of an Ancient Date Seed

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The ability of seeds to remain viable over prolonged periods of time is important in preserving plant genetic resources. Germination of a 1300-year-old lotus seed has been documented; however, other claims of exceptional seed longevity are controversial (*1*).

During the 1963–1965 excavations of Masada, an Herodian fortress overlooking the Dead Sea [built the second half of the first century before the common era (BCE), destroyed 70 common era (CE)], ancient seeds were discovered beneath rubble at the Northern Palace approach (*2*). Stored at room temperature for 4 decades, several seeds were obtained from this collection in 2005, all from the same archaeological area and botanically identified as dates (*Phoenix dactylifera* L.) (Fig. 1A).

Radiocarbon dating of two date seeds (controls) gave overlapping calibrated calendar ages of 102 ± 53 BCE (range from 206 BCE to 24 CE) and 13 ± 51 CE (range from 113 BCE to 128 CE) (2-σ level) (*3*).Three remaining intact seeds were planted after preparation in a quarantined site (*3*). After 8 weeks, one seed germinated. Its growth over 26 months demonstrated development similar to that of normal date seedlings propagated from modern seeds except for whitish patches on early leaves appearing to lack chlorophyll, possibly because of deficiency of essential nutrients during initial stages of germination (Fig. 1, B to D).

At 15 months, the seedling was transferred into a larger pot. Seed shell fragments clinging to rootlets were radiocarbon-dated (*3*), resulting in calibrated calendar age of 295 ± 47 CE (range 205 CE to 392 CE) (2-σ level). The difference in calendar ages between controls and germinated seed fragment appears to be due to seedling growth with incorporation of 2 to 3% modern carbon, which reduces the measured age by about 250 to 300 years (*4*) (table S1).

High summer temperatures and low precipitation at Masada may have contributed to the seed's exceptional longevity by minimizing free radical generation, an important cause of seed aging (*5*).

The date palm was domesticated over 5000 years ago, with the genotype of each cultivar highly conserved through clonal propagation of offshoots (*6*).

The Judean Dead Sea region was particularly famous for its extensive and high-quality date culture in the 1st century CE (*7*). Over the next 2 millennia, these historic cultivars were lost, and by the early twentieth century relatively few, low-quality date palms mostly propagated from seeds were recorded (*8*).

Preliminary genetic analysis of the germinated seedling and three elite date cultivars currently growing in Israel was performed with random amplified polymorphic DNA [RAPD (*3*)]. Of 399 specific DNA bands generated, over 50% were similar (monomorphic) between the seedling and Moroccan (Medjool), Egyptian (Hayani), and Iraqi (Barhee) cultivars. Polymorphic bands representing genetic differences were greatest compared with Moroccan (35.3%), with fewer differences between Iraqi (16.5%) and Egyptian (19.5%) cultivars (table S2 and fig. S1). As products of sexual reproduction, seedlings differ from their progenitors and original cultivar because each possesses a unique genotype, half paternally, half maternally derived.

On the basis of a single specimen of unknown origin, these data can therefore provide limited information on the genotype of ancient cultivars, but they are nevertheless important because they may contribute to our understanding of the contemporaneous Judean date population that flourished in the Dead Sea region 2000 years ago.

Germination of ancient seeds can provide valuable insights into the history of domestication and historic crops and has important implications for seed banking and conservation. Our case may also prove to be important to modern date palm cultivation.

References and Notes

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Supporting Online Material
www.sciencemag.org/cgi/content/full/320/5882/1464/DC1
Materials and Methods
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References

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Fig. 1. (**A**) Ancient date seeds from Masada. (**B**) Germinated seedling age 3 months: normal development of simple juvenile leaves. Height = 15 cm. (**C**) Age 7.5 months: some leaves showing white patches. Height = 31 cm. (**D**) Age 26 months: normal seedling development with compound leaves. Height = 121 cm. [Photo credit: G. Eisner]