

Abstract

Welsh onion (*Allium fistulosum* L.) also known with other names such as Chinese spring onion, Japanese bunching, onion stone leek or Chinese onion, is a vegetable popularly grown in several Asian countries, including Japan, China, Korea, Taiwan, Indonesia, and Malaysia. It has been later introduced and widespread in the western countries, which is more commonly called salad onion, as an alternative to onion (*Allium cepa* L.) cultivars for the production of fresh onion leaves and pseudo-stems. Welsh onion seed storability is one the most critical and key factors of this species, which could have negative effects, if not persevered in ideal conditions. The complicated management of sales forecast and the increasing difficulty of seed production, also due to climate change, make suitable seed storing a critical component to ensure seed availability for the growers, and therefore a stable supply of the fresh Welsh onion into the market. There are different storing procedures that have been proved to be effective keeping seeds for more than 5 years, such as freezing under -18°C or storing under vacuum, however they are expensive and difficult to apply on big seed volumes, and for this reason temperature and relative humidity (RH) control are essential components for ideal storing conditions. The aim of this research was to conduct experiments and evaluate the effect of air temperature and RH on quality parameters of stored Welsh onion (*Allium fistulosum* L.) seed and relate them also to the energy cost needed to maintain such conditions. Consequently, two hypotheses have been elaborated for this dissertation: (I) Welsh onion seeds with moisture content below 10% can be stored under controlled temperature and air humidity for 30 months without a quality loss, (II) the accumulation of reactive oxygen species in Welsh onion seeds stored for 12 and 22 months is limited under controlled temperature and air humidity. The experiments were carried out from April 2018 until February 2021. During this time germination analyzes were carried out following the ISTA, International Seed Testing Association, protocols and conducted every four-month period. Also, mycological analyzes were made, after the first and second year of storage, to test level of infestation by determining the appearance of fungi colonies and their sporulation. In reference to the reactive oxygen species, which have a negative effect on seed ageing, the methodology adopted was the DFCH-DA assay and detected by a fluorescence spectroscopy. The results obtained from this research can be used as a guideline for the storage in climatic and RH controlled chambers of all genotypes belonging to *Allium fistulosum* species, with the aim to maintain its seed high seeds germination related to the duration of the storage and taking into consideration the operating energy costs. Seeds of the tested genotypes kept good germination at $7-8^{\circ}\text{C}$ and at 10°C . By storing them at $7-8^{\circ}\text{C}$ and 10°C , the same effect was achieved. In seeds of 3 genotypes (270322, 1240694, 170403214), after storing them for 30 months, their germination was better at the air RH 45% than at 25%. The calculated electricity costs for 30-month seed storage at 10°C was 11.2% lower than at $7-8^{\circ}\text{C}$. From the company's financial point of view, considering the electricity cost, seed storage at 10°C is more recommended than at $7-8^{\circ}\text{C}$. Generally, the

temperature 7-8°C favoured growth of *Penicillium* spp. and *Phoma* sp. on Welsh onion seeds during 2 years of storage, while in seeds stored at 25°C it increased seed infestation with *Cladosporium* spp. and *Fusarium* spp. In relation to the reactive oxygen species the search for effective indicators of poor seed storability, detected through assays was proved to be a proper strategy, while at the same time, seed technologists should continue their work to improve the current storage protocols, by refining parameters such as temperature, seed moisture content, and gaseous compositions of the storage atmosphere. Seeds from onion and onion-like cultivars still represent a challenge for breeders and seed technologists, due to their storability. Given the complexity of the physiological mechanisms and molecular players involved in seed longevity, a comprehensive evaluation of these dynamics will require extensive studies at a multidisciplinary level. At the same time, efforts should be focused on exploring the impact of the storage protocols on the longevity of primed seeds, by screening hallmarks of seed deterioration such as ROS levels, lipid peroxidation and DNA damage. On the other hand, the environmental conditions during seed maturation of the mother plant dictate the initial quality of seed lots, before storage. Thus, at the company level, data concerning the origin and history of seed lots should also help operators in their management activities.