Aging in orthodox seeds is a problem

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ABSTRACT

Seed deterioration is loss of seed quality, viability and vigor due to effect of adverse environmental factors. Many of our crops are reproduced through seeds, and throughout the world large quantities are produced, stored and transported. Seed ageing during storage may cause retardation of field establishment, and may eventually result in seedling abnormalities or even failure of emergence. During storage in gene banks, seed ageing may result in loss of genetic diversity. Extending and predicting the longevity of stored seeds is therefore highly relevant from a biodiversity as well as from an economic and social point of view. Seed rich in lipids has limited longevity due to its specific chemical composition. During storage of oily species declining trend of total oil content and seed germination can be observed. A fatty acid composition is the most important factor which determines oils susceptibility to oxidation Regardless of the problems which can be encountered due to the lack of space with favourable conditions, one must always keep in mind that seed is a living organism in which many biological processes, which can damage the seed and reduce its quality, take place, especially when the oily seed is in question.

Key words: Aging and seed

Orthodox seeds and aging

With regard to the storability of seeds, there are two groups; orthodox and non-orthodox or recalcitrant in behavior under drying (Roberts 1973).Orthodox seeds are characterized by their ability to tolerate desiccation and to retain their viability for a long time in the dry state. viability of orthodox seeds is relatively easily sustained by lowering their moisture contents and storage temperature, but they gradually deteriorate and finally die even under such suitable conditions for storage. Various theories have been invoked to explain the longevity of orthodox seeds in storage under conditions of low temperature and moisture content (see Vertucci and Roos 1990). In orthodox seeds (i.e. seeds which tolerate dehydration), accelerated ageing can be artificially induced at high temperature and high relative humidity (RH) (Priestley, 1986). For example, in sunflower, for example, storage of seeds at 45 C and 100% RH results in a progressive reduction of germination and induces abnormal seedling growth and then finally leads to death (Gay et al., 1991). However, the sensitivity of seeds to accelerated ageing is tightly dependent on temperature and on their water content. At a constant temperature, loss of seed viability is faster with

increasing moisture content (MC), a key factor in seed longevity (McDonald, 1999). Losses in seed quality occur during field weathering, harvesting and storage. Several factors contribute to the susceptibility for seed deterioration. Although highest seed yield in agriculture in normal condition of fertiling and environmental conditions (Shaban, 2013a,b; Beyranvand et al, 2013 and Kiani et al, 2013), but aged seeds has a low yield in best condition same above. During the last 20 years, considerable research has been conducted to understand better the physiology of seed ageing, since the primary processes and their interactions involved in seed ageing are not yet fully understood (McDonald, 1999). Biochemical deterioration during seed ageing has been studied mostly under accelerated ageing conditions using high temperature and high seed water content (McDonald, 1999). Under such storage conditions, seeds typically lose their viability within a few days or weeks. However, these seeds age during storage and eventually lose their ability to germinate. Several comprehensive reviews have identified free radical-mediated lipid peroxidation, enzyme inactivation or protein degradation, disruption of cellular membranes, and damage to genetic (nucleic acids) integrity as major causes of seed ageing(McDonald, 1999). Biochemical deterioration during seed ageing has been studied mostly under accelerated ageing conditions using high temperature and high seed water content (McDonald, 1999). Under such storage conditions, seeds typically lose their viability within a few days or weeks. A review of the literature suggests that there may be several mechanisms of seed ageing (Walters, 1998). For example, lipid peroxidation and the loss of membrane phospholipids are major causes of seed ageing under accelerated ageing conditions (McDonald, 1999). Yet, several studies of long-term storage detected little or no lipid peroxidation and loss of phospholipids from seeds of cucumber , rice, peanuts, soybean (Priestley and Leopold, 1983), and wheat (Petruzzelli and Taranto, 1984). Different studies allowed important progress towards the understanding of seed ageing mechanisms, a major question has been raised whether the mechanisms of seed ageing are the same under such accelerated ageing conditions and underthe cool dry conditions where seeds age over many years.

Seed ageing pathway

The AGE products (i.e. advanced glycosylation end-products) from Maillard reactions occur in both accelerated and naturally aged seed tissues (Wettlaufer and Leopold, 1991; Sun and Leopold, 1995). It was recently found that lipid peroxidation and sugar hydrolysis (formation of reducing sugars) were coupled to the Amadori and Maillard reactions respectively during seed storage (Murthy and Sun, 2000). The content of Maillard products increased in seeds during storage at all moisture and temperature conditions too.

Fatty acid changes

Lipid peroxidation is considered to be a major cause of seed deterioration during prolonged storage (reviewed in McDonald, 1999). The mechanism of lipid peroxidation is relatively well characterized (Hendry, 1993; Frankel, 2005); free radicals attack the unsaturated fatty acids of membrane phospholipids. A decline of seed viability may be related to the peroxidation of phospholipids and consequent membrane damage. Loss of membrane integrity is apparent when excessive electrolyte leakage accompanies seed imbibition (Bewley, 1986). The free radicals generated by membrane damage may subsequently attack other subcellular structures in seeds, including organellar membranes, proteins, and DNA. Polyunsaturated fatty acids are more susceptible to peroxidation than are monounsaturated fatty acids, while saturated fatty acids are the most resistant. Thus preferential loss of polyunsaturated fatty acids in seeds during storage may serve as an indication of lipid peroxidation.

Volatile productions

Esashi et al. (1993) found that various gaseous substances were produced in many plant seeds during long-term storage at subzero temperature and low relative humidity (RH) and that some of the gases are deleterious to seed vigor. Zhang et al. (1995a) found 59 types of volatile compounds from five species of dry seeds using a GC-MS fitted with a cryo-condensation system and identified the major components to be methanol, ethanol, acetone, isopropanol, 2-butanone and various aldehydes, such as acetaldehyde (Ald), 2-methyl-propanal, 2- and 3-methylbutanal. All of these endogenous aldehydes caused seed vigor loss during storage(Zhang et al. 1995a, Zhang et al. 1995b). Zhang et al. suggested that various aldehyde compounds, especially Ald, may be involved in the acceleration of seed deterioration, which often occurs during long-term storage at low RH.

Function of ROS

ROS generation is indeed known to be implicated in plant and animal PCD that occurs during many stresses (Laloi et al., 2004). ROS have been widely cited as being the main factor causing seed ageing during their prolonged storage. In sunflower seeds, loss of viability during ageing has been shown to be associated with an accumulation of hydrogen peroxide (H2O2) and lipid peroxidation and with a decrease in the activity of antioxidant enzymes (Kibinza et al., 2006). Due to the absence of free water in dry seeds, non-enzymatic mechanisms such as lipid peroxidation are likely to be involved in ROS accumulationduring dry storage, but as soon as seeds imbibe, enzymatic mechanisms participate in ROS production. One of the major sources of ROS in metabolically active seeds is the mitochondrial respiratory chain (Bailly, 2004); however, any mitochondrial alteration leads to increased ROS production (Cash et al., 2007).

Storage condition of seeds

Storability of seeds is mainly a genetically regulated character and is influenced by quality of the seed at the time of storage, pre-storage history of seed (environmental factors during preand post-harvest stages), moisture content of seed or ambient relative humidity, temperature of storage environment, duration of storage and biotic agents (Shelar et al., 2008)Under the long-term storage conditions, seeds are likely to be in the glassy state because of the cool storage environment and low seed water content. The extremely high viscosity and low molecular mobility of the seed cytoplasm could prevent or inhibit many deleterious processes (Williams and Leopold, 1989). The low viscosity and enhanced molecular mobility in the rubbery or liquid state would permit certain deteriorative reactions to proceed rapidly, which are otherwise retarded in the glassy state. Thus, the major primary process that initiates seed ageing could be different under different storage conditions. Biochemical and physiological deterioration during seed aging has been studied mostly under accelerated aging conditions using high temperature and high seed water content (McDonald, 1999; Hsu et al., 2003). Under such storage conditions, seeds typically lose their viability within a few days or weeks. Although these studies allowed important progress towards the understanding of seed aging mechanisms, a major question has been raised whether mechanisms of seed aging are similar under conditions of accelerated aging and natural aging. According to some research, lipid peroxidation and the degradation of membrane phospholipids are major causes of seed aging under accelerated aging conditions (Wilson and McDonald, 1986; Walters, 1998; McDonald, 1999). For orthodox or desiccation-tolerant seeds, low seed moisture content, low temperature, or cryopreservation seems to result in an increase in storage life span (Walters, 2004; Walters et al., 2004).

Seed longevity

For both plants, several quantitative trait loci were identified as affecting viability, and these were located on different chromosomes. This behavior suggests that seed longevity is a multigenic trait including various seed traits, including germination under various stresses or Suc and seed oligosaccharide contents (Clerkx et al., 2004).

Conclusion

In conlusion we understand that aging in orthodox seeds is a problem that induces damage to seed vigor and loss it.

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