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Review Article

SEED GERMINATION AND MATURATION UNDER THE INFLUENCE OF HYDROGEN PEROXIDE-A REVIEW

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ABSTRACT

Seeds are highly dehydrated and naturally need water before germination. The primary part of seed germination is water imbibition until important level of water is attained. Once the imbibition is completed, seeds begin to germinate and seed plant emerges out. Hydrogen peroxide was first recognized as a virulent molecule that causes injury at totally different levels of cell organization and therefore losses in cell viability. Seed germination is the most polar part of the plant life cycle, poignant plant growth and productivity. The performance of peroxide in seed germination and seed aging has been illustrated in various studies; but the precise role of this molecule remains unknown. Behind the germinating seeds and young seedlings, there are some levels of peroxide which will be modulated via seed priming or acquisition. Seed aging is additionally ends up in a loss of germination potency that clarifies the harmful impact of H_2O_2. This review evaluates proof that shows H_2O_2 functions as a signal molecule in seed physiology in accordance with the renowned biology and organic chemistry of H_2O_2.Further, it clarifies the abstract of seed priming or acquisition is influencing the inter-related role of peroxide in seed germination and aging.

Keywords: Seed germination, seedling, priming growth, abiotic factors.

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INTRODUCTION

Hydrogen peroxide is a sturdy anti-oxidant that has been used as an application in industrial biotechnology and industrial effluents process. Hydrogen peroxide is a type of reactive oxygen species because mostly free radicals or atoms come from oxygen. Hydrogen peroxide is a form of colourless liquid that is very similar to water. In plant cycle, seed germination is major factor that determines the seedlings nature and proper development of mature plants. Germination is an advance process that initiates with water uptake and involves events related to the transition of a quiescent dry seed to a metabolically active state. The emergence of the embryonic axis through structures surroundings the embryo is taken into account to be an ending of germination [1, 2]. The main factor is associated with germination involve the metabolism reactivation, cellular respiration, mitochondrial biogenesis, DNA repair mechanism and the arrival of reserve mobilization [3-5]. The accumulation of H_2O_2 and other reactive oxygen species has been distinguishing in seed biology during imbibition and also at point of germination. [5-8]. DNA oxidative damage by reactive oxygen species as a source of DNA destructive process during seed storage and germination. Another data states that mRNA is more sensitive to oxidative damage than DNA due to its cellular translocalization and also lack of repair mechanism [9]. However, H_2O_2 is additionally thought to be a signal hub for the regulation of seed dormancy and germination, and therefore the precise regulation of H_2O_2 accumulation by cell inhibitor machinery is crucial to realize a balance between oxidative communication that promotes germination and oxidative damage that stops or delays germination. Recent studies states that the selective oxidization of proteins and mRNAs will act as a positive effector of seed germination [10-13]. Bazin et al. [13] showed that more or less 24 stored mRNAs endure oxidization throughout sunflower (*Helianthus annuus*) once ripening. During germination, H_2O_2 additionally protects against pathogens. $O_2^{\cdot-}$, H_2O_2, and $^{\cdot}OH$ production in radish (*Raphanus sativus*) seeds has been shown to be a proof of the presence of active and developmentally controlled physiological processes that play a presumption role in protective rising seedlings from damages by pathogens [5]. Therefore, reactive oxygen species (mainly H_2O_2) additionally possess antimicrobial activities [14]. Therefore, this review article carried out with a primary factor to evaluate the seed germination and seedling growth effected by hydrogen peroxide.

GERMINATION POTENCY

During germination, some seeds germinate while some don't. Due to this, nurseryman is always on the lookout for response to increase germination yield rate. Alternatively, seed have capability to germinate rapidly, co-ordinately and in a broad range of environmental condition can be restored or discarded. As the process accumulates seed germination process that implies on stored mRNA and proteins [15]. So that harmful effects at the DNA level can result in dismiss the seedling development. Therefore, the mechanisms of cellular repair system especially at the DNA level but also for some certain protein post-translational modifications play a vital role in seed vigor. Due to seed high vulnerability to destructive, abiotic and biotic stresses factors during imbibition, germination of seeds is the most difficult phase of the plant life cycle. The level of reactive oxygen and nitrogen species, persuaded by the storage and environmental conditions will determine a balance between the required signalling events and the oxidative damages [16-18]. In perspective of seed germination, under natural condition, slow growth of seedlings is like a treatment as increase the germination percentage of seeds and seedling growth [19].

Interaction with signalling molecules

The aspects of hydrogen peroxide and nitrous oxide in seed physiology has been plotted broadly, informative

concerning the functions of alternative molecules and on their synergy stay scarce. Each NO and H_2O_2 behaves a parallel move in terms of interrupting germination dormancy and stimulation through interactions with abscisic acid like hydrogen peroxide. The exogenous application of NO imposes seed dormancy and diminishes the repressive effects of abscisic acid on seed germination [20, 21]. Many postulate states that NO could perform a key aspects in germination vigor, that may result come from disturbance between NO and ROS [22, 23]. Interest within the H_2S molecule has mature in plant physiology. This is often because of its signalling functions and interactions with H_2O_2 and NO throughout plant development and stress responses [24-27] and through seed germination[28]. Improved germination and reduces in germination time periods are determined in common bean (*Phaseolus vulgaris*), maize (*Zea mays*), wheat (*Triticum aestivum*), and pea seeds subjected to H_2S treatments [29]. These results recommend that H_2S plays a vital role as a signal molecule that may accelerate the expansion rates of various plant species. Positive effects of H_2S and H_2O_2 treatments on the promotion of mung bean seed germination are ascertained by [30]. Both the H_2O_2 and NO play vital roles in signalling process.

Cooperation of hydrogen peroxide with phytohormones

The interaction between reactive oxygen species and phytohormones signalling network associate that inflect gene expression and cellular oxidation- reduction reaction [31]. Regulation of seed germination is essential for inter-dependence and for counter balance [32-35]. Looking on the biological process concerned, communication between plant hormones and hydrogen peroxide may be either anamnestic or cooperative. Abscisic acid and gibberellin play opposite roles and their parts in dormancy unleash and maturation are essential and well established [1, 4, 34, 36-39]. Therefore, it's tough to differentiate between decisive effects of hydro-priming with plant hormones towards germination because to stimulate seed germination, high doses of abscisic acid don't required, this meant that abscisic acid forbid germination process at high concentration that has not been determined for phytohormones like auxin, cytokinin, gibberllin and ethylene [40].

Cytokinin (plant hormone) has been project to promote the germination process by anamnestically abscisic acid suppression of seed germination process. In the process of seed germination and seedling growth, cooperation between abscisic acid and cytokinin mediated by inter relation between RNA formed regulators are found in Arabidopsis [41]. In the study of *Suaeda acuminta* seeds, the growth regulators (ABA and GA) within the regulation of germination and dormancy of plants were discovered [42, 43]. Many more signalling molecules are interacted between specific plant hormones and triggers like NO [44-46], hydrogen cyanide (HCN) [47], H_2S [28], OH [48], and H_2O_2 [49], that they believed to play a major role in signalling process throughout plant maturation and biotic and abiotic resilience response [50]. During warm season, the seed germination is considerably alert to aerophilous conditions and however abscisic acid, hydrogen peroxide and NO interact between seed redox status and featured [51, 52]. On the contrary, to increase the collection of reactive oxygen species by addition of gibberellin and principally through superoxide and hydrogen peroxide found in radish plants [5] and *Arabidopsis* [53, 54]. Bahin et al. [55] prompt that H_2O_2 plays a job within the seed dormancy of barley through the gibberllin signal activation and biogenesis instead of going with abscisic signalling process. Corbineau et al. [56] thought that at the phase of regulation of seed dormancy via interference between plant hormones and their respective signals, because the data between ethylene and hydrogen peroxide remains restricted and inconsistent during regulation of seed germination and cytokinin conjointly acts with NO in Arabidopsis [57].

Deleterious effects of H_2O_2 in seed aging course

Seed aging and growth process are full of variety of things throughout seed germination and production as well as seed cache. The agility of seed fading methods gamble on seed's capability to resist degraded changes additionally as on its conservation mechanism, that are species-specific in nature. As the aging process increase, variety of repository and characteristics of species altered the degree of seed damage [58, 59]. According to the "free radical theory of aging," the driving force behind most alterations that occur during the aging of living organisms is ROS activity. This assumption also refers to aged seeds and is supported by numerous reports [7, 17, 60-64]. ROS production in dry stored seeds ensues as a result of non-enzymatic processes (e.g., Amadori and Maillard reactions and lipid peroxidation [65]. Seed aging also indulges the continuous accretion of harm to cellular elements that successively leads to a catastrophe of seed growth and vigor. In extreme temperature and wet conditions, the seed storage escalates once seed are hold on to in improper condition [18]. However the seeds depend not only on storage periods and conditions; also reckon to genetic, physiological, and morphological factors like seed germination process and seed structures etc. [66, 67].

In seed aging process, the deleterious aspects of seed aging are normally examined exploitation factitious aging ways (controlled deterioration test and accelerated aging) that indulges seed annotation to warmth (35°C) and wetness/moisture (75%) conditions for comparatively short period of time [68] though the molecular biology of the seed forbid method continues to be not fully understood, it's acknowledged that seed aging affect many harmful changes among cells (DNA damage, loss of membrane integrity, protein inactivation and telomere shortening etc.). An increasing quantity of H_2O_2 and reactive oxygen species throughout seed deterioration is additionally a mirrored image of the progressive deficiency of catalyst scavenger's activities. Amendment of activity and transcription level of key inhibitor enzymes are discovered in aged seed of various species [69-75]. In natural aged alfalfa seeds, lipid peroxidation is that the main product of long - run storage, though there's no co-relation with hydrogen peroxide because the latter remains at an occasional level in aged dry seeds [76].The reactive oxygen species enterprise in aged seeds command to priming analysis [77].

Exertion and effect of H_2O_2 excite – prompt abiotic stress resilience

Seed agility is a major role in agricultural field that regulates a seeds potential for fast reliable and maturation under a wide range of field case [78]. To increase seedling growth and yield (like seedling growth, crop stands and seed production); seed priming or exciting analysis is used in seeds industry [79-82]. During seed vigor and viability, which gives as improved germination performance like increased germination rate germination uniformity) and plant growth especially under detrimental environmental conditions [83-88]. Seed exciting reform the stress resilience of seeds and plant grown from excited seeds based on fast germinated state. The model effects of hydrogen peroxide on plant defense process associated with abiotic stress factor and reactive oxygen species especially H_2O_2 – dependent signalling compounds prompt improved stress response [89]. The beneficial effects of seed priming with hydrogen peroxide in particulars of high temperature resilience in barley and drought resilience in wheat and beans is reported earlier [90-93]. Seed analysis with hydrogen peroxide also takes part in propagation and seedling growth of plants and also modifies exact photosynthetic rates under non-stressed conditions [94, 95]. After all this consummation, it states that the pre- analysis of

seeds with hydrogen peroxide could have analogous effect on propagation pursuance, seedling formation and metabolic processes as exciting analysis, despite the seed soaking process plays an important role in the regulation of gene elucidation and protein augmentation [8]. Inattentive to abiotic stress tolerance through hydrogen peroxide level modulation and regulation of many stress reliable pathways is mentioned earlier. In both seeds and plants, both have the capacity to production of reactive oxygen species provided as an important component of stress resilience [96]. Seed heteromorphism is a term that defines the generation of different seed morphology with peculiar germination characteristics by a solely individual that responding to harmful environment [97, 98]. Chemical derived analysis is less attractive or benefiter than seed priming or exciting in field cost perspective to applied in plants.

CONCLUSION

It has been discussed that pre-propagate seed exciting could be used to improve seed essence regarding better propagation or germination process and higher agility while there some partially abrogate seed aging implement. The proper mechanism and evaluation of hydrogen peroxide during the propagation of excited seeds must be formulate and also signalling pathways collaborate with hydrogen peroxide metabolism. Many studies have been organized on refined plants for agronomy aspects for perceive molecular cycles and biochemically derived processes that influence the seed dormancy and propagation. And the interference with hydrogen peroxide signalling process and other network molecules such as H_2S and plant hormones (Abscisic acid, gibberllin and ethylene) enact a vital role in deflect between dormant and germinated stages.

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