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The Relevance and Purpose of Seed Enzymes in Seed Germination

Kulsumbi A. Korihalli[1] and M. S. Umar Farooq[2]

[1]Research Associate, Ph.D. in Seed Science and Technology, University of Agricultural Sciences, GKVK, Bangalore

[2]Senior Research Fellow, All India Co-Ordinated Research Project on Sunflower, University of Agricultural Sciences, GKVK, Bangalore

SUMMARY

Enzymes work to convert insoluble food into soluble form during seed germination so that the embryo can develop into a plantlet. Energy is required for the germination of seeds and the growth of young plants. This is attained through the digestion of food (starch) stored in cotyledons with the aid of amylase, lipase, and protease enzymes.

INTRODUCTION

The process by which the embryo present in the seed transforms into a plumule and radicle is known as seed germination. Water is absorbed by seeds, causing dormant tissues to enlarge and cell division to begin. The micropylar, which descends and enters the earth, gives rise to the radicle. Later on, these radicles develop into roots that supply the plants with water and nutrients throughout their lives. Amylase, protease, and lipase are a few examples of the enzymes that are responsible for breaking down spare food components like starch, protein, and lipid in seeds so that they may be sent to the embryo as food for energy and other essential nutrients. Protease enzymes catalyse the breakdown of seed proteins into amino acids and peptides, which are then given to the developing embryo. Proteins, enzymes, hormones, pyrimidines, and purine bases are all biosynthesized using the amino acids produced by the metabolism of proteins. The amylase enzyme catalyses the starch, which provides the dietary components necessary for embryonic growth and development. Similar to other enzymes, lipases are in charge of breaking down triacylglycerols into glycerol and fatty acids. The growing embryo gets its energy from this as well.

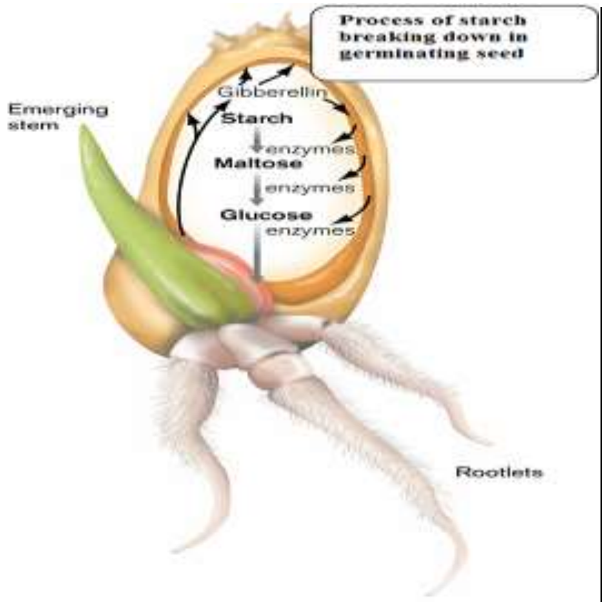
Mechanism of the Seed Germination

The germination process of seeds can be broken down into multiple parts, including the activation of enzymes by water ingestion, the growth of the radicle to root for soil water absorption, and the development of the plumule to shoot for photosynthesis. Seeds begin to absorb water and produce a number of enzymes that aid in the breakdown of the stored food into simpler molecules as germination progresses. To aid in the development of the sprouting seedlings, these products are delivered. At various stages of seed germination, a variety of minerals, proteins, and enzymes play a crucial role in numerous ways. It has been shown that when a seed starts to germinate, the amount of minerals, proteins, vitamins, and enzymes increases by 25 to 400%. The maternal seed coat protects the developing seed's triploid endosperm and diploid embryo. In dicots, the embryo occupies a large portion of the seed along with the bulk of the lipid and protein reserves. The primary storage location for starch and storage proteins in grains is the endosperm.

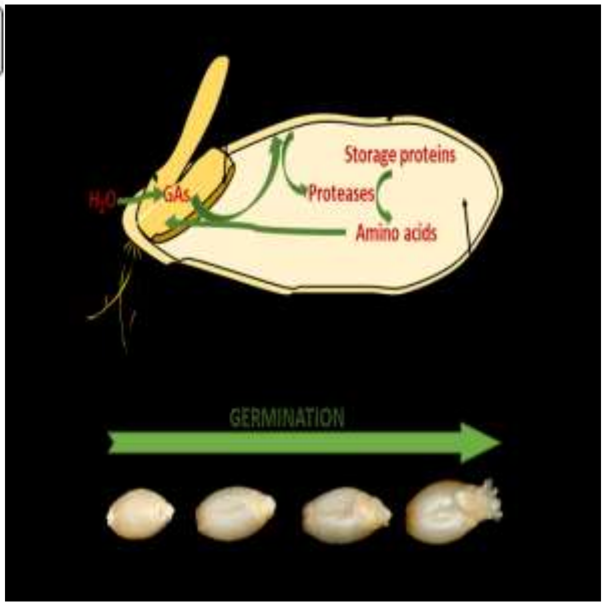
Significant role of protease, amylase and lipase during seed germination and development

Proteolytic enzyme activity rises during the first seven days of seed germination. Additionally, it has been noted that protease inhibitors, which are proteins by nature disappear. Protein that is stored in seeds is hydrolyzed or catalysed, releasing free amino acids. The manufacture of the protein in the endosperm and embryo, which eventually comes before the germination process, is aided by these free amino acids**.** Most plant seeds contain between 70-80 % starch. In seed, different hydrolysis enzymes are produced in the aleurone or scutellum region in response to germination cues. Many enhanced seed systems were passed down to detect the induction process and identify potential factors governing enzyme induction in the absence of an embryo. Following is a summary of the significance of -amylase function during seed germination under various environmental stresses, including heat stress, drought stress, etc. High -amylase activity directly promotes water stressed seed germination, but it may also be linked to an adaptive response to water shortage because it is necessary for solute build up and osmotic potential reduction.

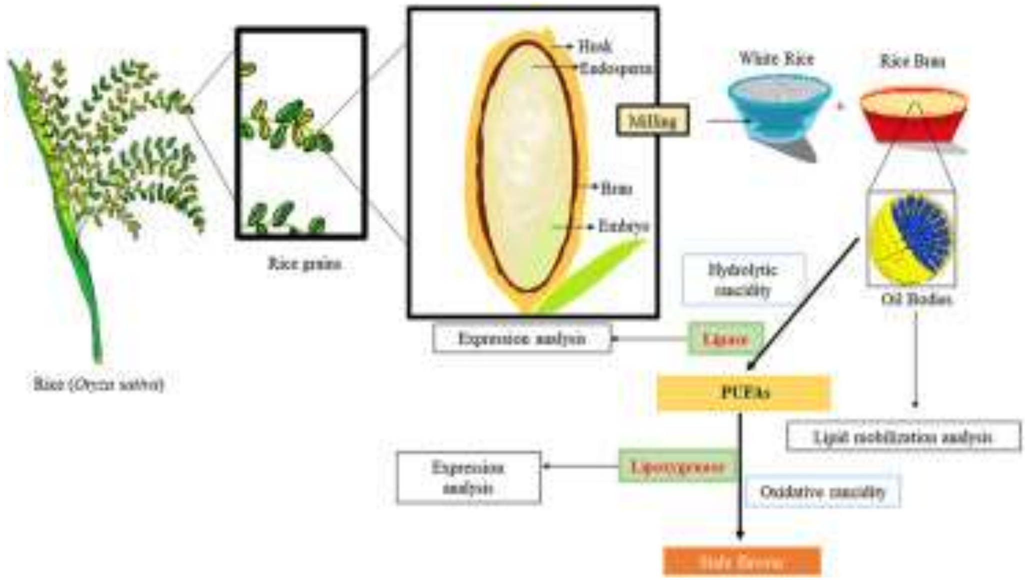
Oilseeds typically come in two parts: the primary part, the kernel, and the seed covering, often known as the tegument or husk. The endosperm and the embryo were both present in the kernel. During seed germination, when oil content is at its highest, the Lipase enzymes' activity are examined. Triacylglycerols make up between 20-50 percent of the dry weight of oleosomes. Triacylglycerols are destroyed or hydrolyzed as germination progresses to produce energy that is essential for the manufacture of sugars, amino acids (such as aspartate, asparagine, glutamate, and glutamine), and carbon chains that are essential for embryonic growth and development. Numerous germination seeds showed a variety of lipase enzyme activity and lipid levels. The lipases, which catalyse the hydrolysis of ester carboxylate bonds and liberate organic alcohols and fatty acids as well as being involved in esterification (reverse reaction) or even a number of trans-esterification reactions, are the most significant hydrolytic enzymes associated with the lipid catalysis during seed germination.



a) amylase enzyme



b) protease enzyme



c) lipase enzyme

Figure 1. Depicts the role of major seed enzymes during seed germination

CONCLUSION

Different variables in the environment, such as soil type, moisture content, and temperature, have an impact on seed germinate. In addition, the enzymes are essential for seed germination, growth, and development. The germination process can't go on without enzymes. The stored food materials in a seed's cotyledons provide the seed with energy for growth and development. Before it can be used for the growth and development of the embryo, the food that has been stored is typically found as starch, an insoluble sugar molecule. After the seeds have absorbed water from the soil, starch is generated in the seeds and is catalysed by amylase enzymes. For the seeds to use the starch, it must first be converted by enzymes into soluble sugar. After the seeds have absorbed water from the soil, amylase is formed in the seeds. It breaks down starch to produce maltose, which aids in the germination process. Other enzymes, such as lipase, which breaks down lipids, protease, which aids in breaking down the protein contained in seeds, and -1, 3-Glucanase, which catalyses -1, 3-Glucan, also aid in the germination process.

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