Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 2617-2623

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 Special Issue-11 pp. 2617-2623
Journal homepage: http://www.ijcmas.com

Review Article

Seed Invigoration: An Overview

Yalagandhula Abhilash, A. H. Madakemohekar*, M. Shanmukha Reddy, PragadaVenkata Yaswanth and Kondru Swetha

Department of Genetics and Plant Breeding, School of Agriculture, Lovely professional University, Phagwara- 144411(Punjab), India
**Corresponding author*

A B S T R A C T

Seedling establishment is an important factor and largely depends on the seed germination and vigour. Seed priming has the potential to enhance the seed vigour and germinability of normal seeds. It has the excellent ability to revive the partially aged seeds and improve the germination power. There is a need to standardize this technology in every crop species. In grain legumes the major factors affecting seed quality are imbibition damage, seed ageing and their interaction. Seed ageing is also the major cause of reduced seed quality in vegetable species. An approach to their seed improvement has been the development of seed invigoration treatments based on seed hydration. The principle of these treatments is described and several treatments mentioned, with emphasis being given to aerated hydration, a treatment completed within 36h. The physiological basis of improvement by invigoration is discussed.

Keywords

Seed priming, Seed vigour, Grain legumes, Vegetables, Vigour, Ageing, Invigoration treatments

Introduction

Failure or weakening of seed is a difficult issue in tropical and subtropical nations like India where high temperature and moistness quicken the seed maturation. As seed matures, they come to sprout more gradually than new seeds, rate of respiration reduces, vulnerability to pathogens increases, chromosomal variations from the normal and expanded extent of morphologically anomalous seedlings. All the physiological boundaries viz., germination rate, feasibility rate, seedling length, seedling dry weight, vigour index, field emergence index, seedling establishment and DHA activity were diminished fundamentally with progress of maturing period (Kumar, 2004 in onion; Desraj, 2002 in coriander and Kumar, 2010 in coriander). Utilization of value seed is the main factor as quality seeds guarantee better germination just as better yield. The seedling establishment of yields is impacted by the nature of the seed utilized (De Figueiredo *et al.,* 2003). Seed priming is a compelling innovation to improve quick and uniform emergence and to accomplish high vigour, prompting better stand establishment and yield. Seed priming is one of the pre-planting seed that board procedures where the seeds are partially soaked and hence dried back for invigorative impact that expresses on field emergence and stretch out up to yield. Priming applications contribute to essential improvement in seed germination and seedling development in vegetables (Dursun and Ekinci, 2010; Korkmaz, 2005; Korkmaz and Pill, 2003).

Improved seed invigoration strategies are notable to reduce emergence time, achieve uniform emergence and give better crop stand in numerous horticultural crops and these incorporates hydro priming, osmo conditioning, hormonal priming and drenching prior to planting (Ashraf and Foolad, 2005). Priming of seeds has been utilized as pre planting treatment for seed lots that have lost vigour and viability because of inappropriate storage conditions (Pan and Basu, 1985 in carrot and Singh *et al.*, 2001 in muskmelon). Harris *et al.*, (2007) detailed that seed priming prompted better establishment and growth, prior blooming, increment seed tolerance to antagonistic climate and more prominent yield in maize. Legitimate standardization of the pre-planting seed treatment technique and strategy for singular harvests and cultivars is the main determinant of the achievement of seed priming. Seed enhancement through priming has led to extraordinary enhancements in farmer's capacity to accomplish this objective in the field and under controlled environment/nursery (Amin *et al.*, 2016). Priming responses were ascribed fundamentally to quick seedling establishment, higher plant stand and earlier crop maturity permitting escape from end-of season stresses (Harris, 1996). The critical premise of all pre sowing is to hydrate the seed under controlled conditions, so they become physiologically dynamic and along these lines they can initiate repair mechanisms and detoxify the framework (Devaraju *et al.*, 2011).

Essentiality of seed invigoration

Seed invigoration methods are utilized in the addition of value to the treatment's applied on a given seed part to improve its field execution. This term is regularly utilized conversely with seed priming. However, this terminology relates to the explanation of various techniques containing numerous presowing procedures. Seed invigoration or seed enhancements are "post-harvest treatments to improve germination and seedling development or to encourage the conveyance of seeds. Also, different materials needed at the hour of planting" (Taylor *et al.*, 1998). Seed invigoration contains a lot of techniques through which the value addition of the seed is done. Various gradational techniques regarding seed invigoration are mentioned in a detailed manner in the below diagrammatic representation.

Biochemical activities due to priming

Improvement in germination, stand establishment and financial yield owed from seed priming can be clarified on a physiological, biochemical and molecular basis. Seed-priming strategies increment the activities of hydrolases and some other enzymes (counting cell reinforcements under pressure conditions), which improve the breakdown of reserve food. Meanwhile, some different metabolites are additionally synthesized. Nucleic acids and protein biosynthesis are likewise enhanced by seed priming techniques which include various strategies. Seeds represent to an all-around characterized framework as a sink, where resources are used for the creation of seedlings. Rice seeds store starch, storage proteins, and a limited quantity of oils in the endosperm. Hydrolytic enzymes are chiefly responsible for the hydrolysis of these reserves into the useable and promptly accessible source of energy for embryo development. Seed priming is accounted for the modulation of carbohydrate metabolic activities (Kaur *et al.,* 2000, 2002), accordingly expanding the accessible nutrition for the developing embryo. Studies on rice demonstrated that priming builds the movement of hydrolytic catalysts and neutralizes the impacts of lipid peroxidation. During priming, synthesis of α-amylase has been archived (Lee and Kim 2000). The α-amylase movement is related directly with the metabolic activity, prompting to higher vigour of the rice seeds (Basra *et al.,* 2005; Farooq *et al.,* 2006).

Fundamentally higher and faster germination of osmoprimed rice seeds under low temperature (5◦C) and salt (0.58% NaCl) stresses were noticed. Be that as it may, no critical changes in the exercises of seed α-amylase and root framework dehydrogenase were noticed, while activities of seed β-amylase and shoot catalase were enhanced in low temperatures (He *et al.,* 2002). Under salt stress, a huge increase in the movement of seed α-amylase, β-amylase, and root framework dehydrogenase, and a moderate ascent in the activity of shoot catalase happened (He *et al.,* 2002).

Lee and Kim (2000), while examining the impacts of osmoconditioning and hardening on the germination of normal and naturally aged seeds, demonstrated that the α-amylase activity of ordinary seeds was more noteworthy than the aged ones; the latter is being more viable than the previous.

The α-amylase activity was positively correlated with the total sugars and germination rate. The increase in gibberellic acid concentration and the continuance exposure increased the α-amylase activity and seed germination (Vieira *et al.,* 2002). Lanthanum ion has been discovered to be successful in modulation of the activities of seed enzymes in rice. The impact of soaking in lanthanum salt on the germination and seedling development of rice demonstrated that the scope of 1–20 mg L^{-1} increased the vigour and proteinase, amylase, and lipase activities of seeds (Zhang *et al.*, 2005).

Invigoration in seed technology

The advancement of seed invigoration treatments began with seed priming, as first depicted by Heydecker *et al.,* (1973). Priming is expected to control seed hydration so that all seeds arrived at a similar phase of germination prior to planting, so resulting germination was fast and synchronous. This was accomplished by permitting seeds to imbibe from a solution of polyethylene glycol (PEG) with the end goal that imbibition stopped when the seed water potential equalled that of the PEG arrangement, and was accomplished at a seed moisture content underneath that needed for germination.

In this manner all seeds arrived at a similar phase of "suspended animation" prior to planting. Diverse priming conditions have been applied to numerous species differing the groupings of PEG (and accordingly concentration utilized), temperature and timing of treatment. Upgrades in the rate and synchronous germination have been accomplished in a scope of species (Heydecker and Coolbear, 1977).

Early priming treatments included planting-soaked seeds following treatment. This led to the enhancements noticed being described as the result of a progression of germination (Heydecker and Coolbear, 1977). Nonetheless, at times when seeds were dried after treatment, some level of progress was held, prompting the recommendation that metabolic repair may likewise be associated with the response to priming (Fig. 1 and 2).

Fig.1

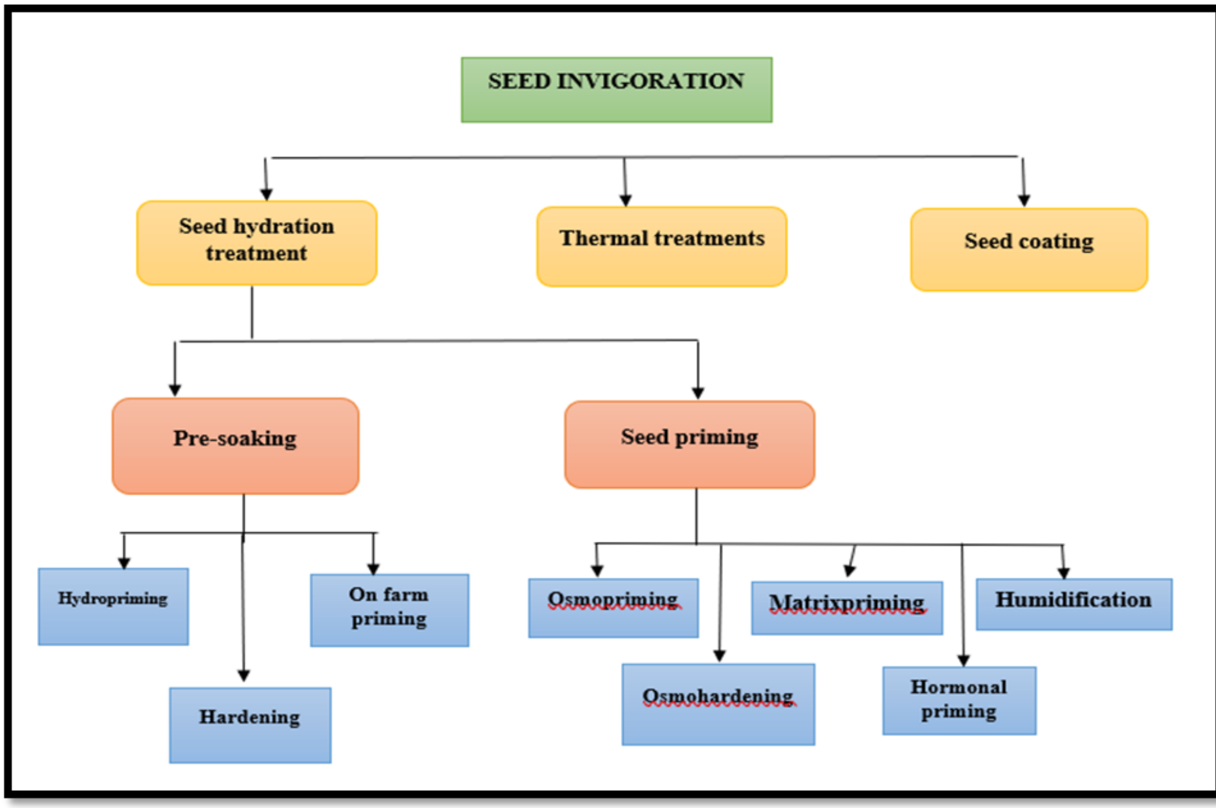
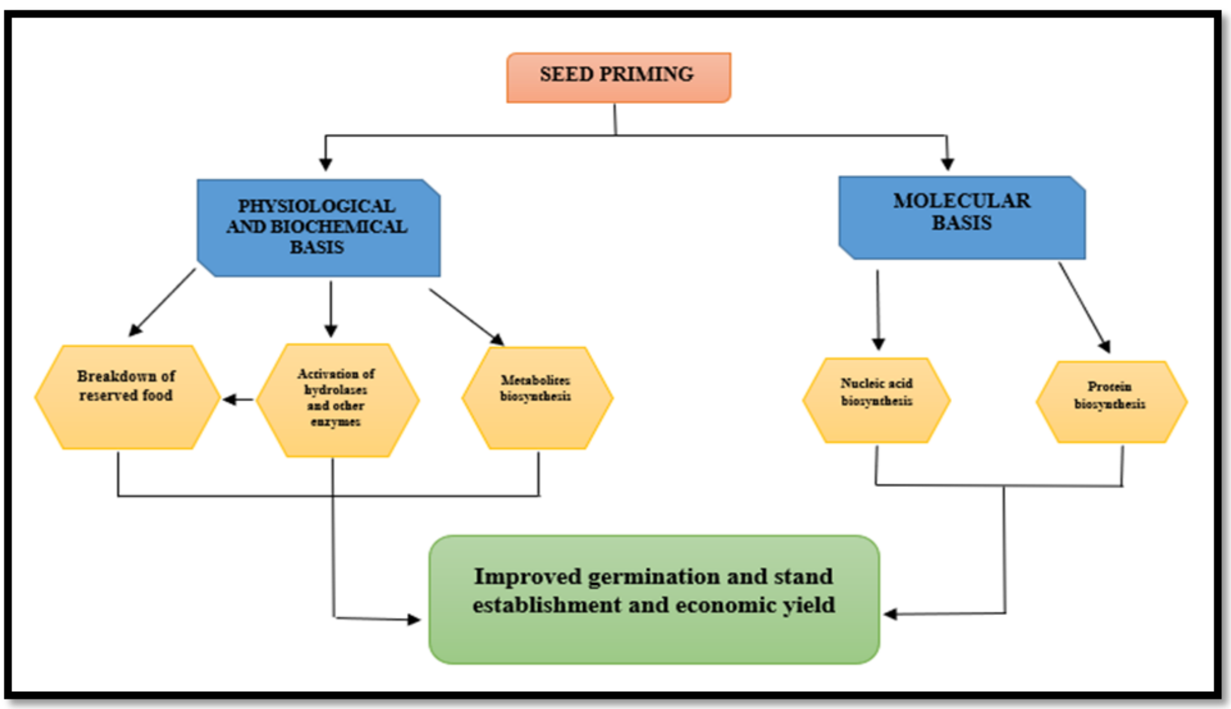

SEED INVIGORATION
Seed hydration treatment
Thermal treatments
Seed coating
Pre-soaking
Seed priming
Hydropriming
On farm priming
Hardening
Osmopriming
Matrixpriming
Humidification
Osmohardening
Hormonal priming

Fig.2


SEED PRIMING
PHYSIOLOGICAL AND BIOCHEMICAL BASIS
MOLECULAR BASIS
Breakdown of reserved food
Activation of hydrolases and other enzymes
Metabolites biosynthesis
Nucleic acid biosynthesis
Protein biosynthesis
Improved germination and stand establishment and economic yield

Subsequently, priming treatments have reliably included drying the seeds back as this makes ensuing handling and planting of the seeds simpler.

The principle of utilizing controlled hydration in seed invigoration has additionally been utilized in various different treatments that vary in their methods for controlling hydration (Khan, 1992). These incorporate drum-priming (Rowse, 1996), solid matrix priming (Taylor *et al.,* 1988), hydropriming (Van Pijlin *et al.,* 1996) and aeriated hydration (Thornton and Powell, 1992).

In drum-priming, seed moisture content is raised by the expansion of an exact volume of water to the seeds while during solid matrix priming and hydropriming seeds imbibe until their water potential arrives equilibrium with a moist dormant medium or humid atmosphere individually. These treatments can take as long as 14 days. The last strategy for seed invigoration to be considered here, aeriated hydration, was developed at the University of Aberdeen, and varies from the others in that it relies upon time alone to control the degree of seed hydration during a treatment period that is typically under 36h.

The accurate choice of priming duration and method are important to attain maximum benefits from seed priming techniques. These includes hydro priming, osmo conditioning and soaking before sowing. In grain legumes, production can be modified to reduce the incidence of cracked Testa. Seeds can be carefully controlled and monitored to avoid seed ageing by the utilization of various seed invigoration techniques. In various crop species, the use of seed invigoration treatments can enhance seed quality. However, research work regarding seed invigoration has to be improved to maintain the consistent development in seed technology.

References

Amin R, AZ Khan. A Muhammad, SK Khalil, H Gul, G Daraz, H Akbar, AM Ghoneim. Influence of seed hardening techniques on vigour, growth and yield of wheat under drought conditions. Journal of Agricultural Studies. 2016; 4 (3): 121-131

Ashraf M, MR Foolad. Pre-sowing seed treatment-a shotgun approach to improve germination growth and crop yield under saline and non-saline conditions. Advances in Agronomy. 2005; 88:223-271.

Basra S.M.A., Farooq M., Tabassum R. (2005) Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (*Oryza sativa* L.), Seed Sci. Technol. 33, 623–628.

De Figueiredo E, MC Albuquerque, NM de Carvalho. Effect of the type of environmental stress on the emergence of sunflower (*Helianthus annuus* L.), soybean (*Glycine max* L.) and maize (*Zea mays* L.) seeds with different levels of vigour. Seed Sci. Tech. 2003; 31, 465-

Desraj. Studies on viability and vigour in coriander (Coriandrum sativum L.). M. Sc. Thesis, submitted to Chaudhary Charan Singh Haryana Agricultural University, Hisar, 2002.

Devaraju PJ, S Nagamani, RV Gowda, HS Yogeesha, R Gowda, KS Nagaraju, N Shashidhara. Effect of chemo priming on plant growth and bulb yield in onion. Int. Jr. of Agril., Env. & Biotech. 2011; 4:121-123

Dursun A, M Ekinci. Effects on different priming treatments and priming durations on germination percentage of parsley (*Petroselinum crispum* L.) seeds. Agricultural Sciences. 2010; 1(1): 17-23

Farooq M., Basra S.M.A., Khalid M.

Tabassum R., Mehmood T. (2006) Nutrient homeostasis, reserves metabolism and seedling vigor as affected by seed priming in coarse rice, Can. J. Bot. 84, 1196–1202

Harris D, Rashid A, Hollington A, Jasi L, Riches C. Prospects of improving maize yield with on farm seed priming. In. Rajbhandari, N.P. and Ransom, J.K. 'Sustainable Maize Production Systems for Nepal'. NARC and CIMMYT, Kathmandu, 2007, 180-185

Harris D. The effects of manure, genotype, seed priming, depth and date of sowing on the emergence and early growth of Sorghum bicolor (L.) Moench in semi-arid Botswana. Soil and Tillage Research. 1996; 40:73-88

He C.Z., Hu J., Zhu Z.Y., Ruan S.L., Song W.J. (2002) Effect of seed priming with mixed- salt solution on germination and physiological characteristics of seedling in rice (*Oryza sativa* L.) under stress conditions, J. Zhejiang Univ. (Agric. Life Sci.), 28, 175–178.

Heydecker, W.; Coolbear, P. Seed treatments for improved performance - Survey and attempted prognosis. Seed Science and Technology, v.5, p.353-425, 1977.

Heydecker, W.; Higgins, J.; Gulliver, R.J. Accelerated germination by osmotic seed treatment. Nature, v.246, p.42-44, 1973.

Kaur S., Gupta A.K., Kaur N. (2000) Effect of GA3, kinetin and indole acetic acid on carbohydrate metabolism in chickpea seedlings germinating under water stress, Plant Growth Regul. 30, 61–70.

Kaur S., Gupta A.K., Kaur N. (2002) Effect of osmo- and hydropriming of chickpea seeds on seedling growth and carbohydrate metabolism under water deficit stress, Plant Growth Regul. 37, 17–22.

KHAN, A.A. Preplant physiological seed conditioning. Horticultural Reviews, v.13, p. 131-191, 1992

Korkmaz A. Inclusion of Acetyl Salicylic Acid and Methyl Jasmonate into the Priming Solution Improves Low-temperature Germination and Emergence of Sweet Pepper. Hort Science. 2005; 40(1):197-200.

Korkrmaz A, WG Pill. The Effect of Different Priming Treatments and Storage Conditions on Germination Performance of Lettuce Seeds. European Journal of Horticultural Science. 2003; 68(6):260-265

Kumar A. Seed quality assessment in naturally aged seeds of onion (Allium cepa). M.Sc. Thesis, submitted to Chaudhary Charan Singh Haryana Agricultural University, Hisar, 2004.

Kumar V. Studies on seed viability and vigour in naturally aged seeds of coriander (*Coriandrum sativum* L.). M. Sc. Thesis submitted to Chaudhary Charan Singh Haryana Agricultural University, Hisar, 2010.

Lee S.S., Kim J.H. (2000) Total sugars, α-amylase activity, and germination after priming of normal and aged rice seeds, Kor. J. Crop Sci. 45, 108–111.

Lee S.S., Kim J.H. (2000) Total sugars, α-amylase activity, and germination after priming of normal and aged rice seeds, Kor. J. Crop Sci. 45, 108–111.

Pan D, RN Basu. Mid storage and pre-sowing seed treatment for lettuce and carrot. Scientia Horticulturae. 1985; 25:11-19.

ROWSE, H.R. Drum priming - a non osmotic method of priming seeds. Seed Science and Technology, v.24, p.281-294, 1996.

Singh G, Gill SS, Sandhu KK. Storage of primed seeds of muskmelon (*Cucumis* *melo* L.). Seed Science Research. 2001; 29(2):235-237.

Taylor A.G., Allen P.S., Bennett M.A., Bradford J.K., Burris J.S., Misra M.K. (1998) Seed enhancements, Seed Sci. Res. 8, 245–256.

Taylor, A.G.; Klien, D.E.; Whitlow, T.H. SMP: solid matrix priming of seeds. Scientia Horticulture, v.37, p.1-11, 1988.

Thornton, J.M.; Powell, A.A. Short term aerated hydration for the improvement of seed quality in *Brassica oleracea* L. Seed Science Research, v.2, p.41-49, 1992.

Van Pijlin, J.G.; Groot, S.P.C.; Kraak, H.L.; Bergervoet, J.H.W. Effects of pre-storage hydration on germination performance, moisture content, DNA synthesis and controlled deterioration of tomato (*Lycopersicon esculentum* Mill.) seeds. Seed Science Research, v.6, p.57-63, 1996

Vieira A.R., Vieira M.G., Fraga A.C., Oliveira J.A., Santos C.D., Vieira G.G., Santos C.D. (2002) Action of gibberellic acid (GA3) on dormancy and activity of alpha-amylase in rice seeds, Rev. Bras. Sementes 24, 43–48.

Zhang J., Liu D., Huang Y., Liu X. (2005) Effects of seed soaking with La3+ on seed germination and seedling growth of rice, Chin. J. Ecol. 24, 893–896.