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Review Article

Seed Priming; An Effective Way to Improve Plant Growth

Muhammad Adnan[1]*, Hafiz Abd-ur-Rahman[1], Muhammad Asif[1], Mubashir Hussain[1], Hafiz Muhammad Bilal[2], Muhammad Adnan[2], Fazal-ur-Rehman[3], Sohail Ahmad[3] and Mozna Khalid[4]

[1]Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan

[2]Department of Horticulture, College of Agriculture, University of Sargodha, Pakistan

[3]Department of Plant Pathology, College of Agriculture, University of Sargodha, Pakistan

[4]Sulaiman Bin Abdullah Aba Al-Khail, Centre for Interdisciplinary Research in Basic and Applied Sciences, IIUI Islamabad, Pakistan

***Corresponding Author:** Muhammad Adnan, Department of Agronomy, College of Agriculture, University of Sargodha, Pakistan.

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Abstract

Seed priming is a technique which is used to improve seed germination and crop stand in field. Efficient modes of seed priming include Hydro priming, Halo priming, Osmo priming and Solid matrix priming. Hydro priming is easy and more economical mode of priming which increases seed germination, reduce germination time and improves root-shoot ratio. Halo priming is performed by dipping seeds in salt solution and it positively affects the germination. Osmo priming and solid matrix priming enhances the salinity tolerance and improves the plant growth. The present review highlights priming methods to increase seed germination rate, plant stand establishment and improve seedling vigor for better crop production.

Keywords: *Seed Priming; Germination; Stand Establishment; Priming Methods*

Introduction

For optimizing agriculture production, plant stand establishment is very important. Poor germination of seeds and suboptimal environment conditions are common in field conditions. Sometime, seeds are sown when temperature and moisture of soil is suboptimal for germination. Globally, abiotic stresses are major problems and affects seed germination, vigor and emergence of crop. Different methods can be used to improve the agricultural production while seed priming is the most suitable and simple technique to increase germination, emergence and yield [1].

Seed priming theory was proposed by Heydecker., *et al* [2]. It is a technique which is used prior to seed sowing, it includes seeds hydration to permit metabolic events prior to germination while prevents emergence of radicle [3]. Improvement in metabolic events improves the speed of seed germination in vegetables, ornamental species and some small seeded grasses. There are many methods of seed priming such as halo priming, hydro priming, osmo priming, matrix priming. Seed priming is simple, easy, low cost, highly effective and low risk method. Halo priming is soaking of seeds in salts (KNO_3, NaCl, $CaSO_4$ and $CaCl_2$). In salt affected and normal soils this technique improve the seed germination [4]. Hydro-priming is the soaking of seeds in water before sowing and it may improve the germination and emergence under normal and saline conditions [5]. Osmo priming is the priming of seeds in PEG (sugar solution). Seed priming has many beneficial effects on field crops such as wheat, sugar beet, sunflower and soybean. Priming can enhance farmer's income by increasing

yield and crop emergence rate. Crop seeds grown after priming showed rapid germination than unprimed seeds [6]. So, seed priming can be used by farmers to increase germination, uniformity of plants in field.

Seed priming is basically an effective method which is used to enhance germination, emergence, vigor, plant stand and final yield. Seed priming improves growth, earlier flowering, increase tolerance to abiotic stresses and final yield of maize. Priming cause different physiological and biochemical changes in seeds and break dormancy. Priming increased the activity of â-mannanases and break the dormancy [6]. Seed priming involves seed treatment with various organic and synthetic chemicals [7]. In maize, wheat, and rice direct advantages of seed priming are quick emergence, better crop stands, drought tolerance, early flowering and higher seed yield. The indirect benefits are early sowing and harvesting [8]. Seed priming with proper technique can promote healthier and faster establishment of early planted crops and increase tolerance against harsh conditions of environment. Seed priming of mustard seeds increased stem germination and dry weight [9]. Highest characteristic of germination were obtained when seeds were primed under control conditions. Priming increased reserve utilization and millet seeds growth.

Methods of seed priming

Seed priming involves hydro priming and halo priming, osmo priming and solid matrix priming. Every crop requires optimum and specific priming technique such as optimum time, amount, storage conditions and cultivar [8].

Hydro-priming

Soaking of seeds in simple water prior to sowing increase germination speed, homogeneity of emergence and better plant stand. This process increases the germination rate. Hydro-priming significantly affect plant weight, root length, roots number, shoot length, vigor index and time taken to 50% percent emergence in forage sorghum. Seed priming promotes cell division and speed up the emergence of the forage sorghum. Seed priming with plain water increased the germination indices, crop establishment and seedling growth of wheat crop. Seed priming with water is cheap and simple method, which have potential to improve seedling emergence homogeneity, germination percentage under water stress (drought) conditions and this technique can be easily used and adopted by the farmers [10]. The performance of bean seeds increased due to hydro priming [11]. Hydro priming increased seed germination of gladiolus seeds [12]. Hydro priming increased seed germination, seedling vigor and fruit yield of okra [13]. Hydro priming of cowpea seeds significantly increased seed emergence, seed germination and plant height [14]. Priming of soybean seeds with water significantly increased the germination rate, stem weight, pods number plant^{-1}, seed dry weight and seed yield [15].

Halo priming

Halo priming is a technique in which seeds are soaked in inorganic salts like $CaCl_2$, KNO_3, NaCl, $CaSO_4$ etc. Numbers of studies have shown a significant improvement in seed germination, seedling emergence and establishment and final crop yield in salt affected soil in response to halo-priming [4]. Priming of lettuce seed with 1% K_3PO_4 for 20 hours improved seed germination (86%) [16]. Priming of tomato seeds with 1% KNO_3 and 5% K_3PO_4 significantly improved germination rate [17]. Priming of soybean seeds with KH_2PO_4 (2%) increased germination and final yield as compared to control (no priming). Seed priming with nitrate salts may control the critical yield parameters even in adverse conditions of environment in several crops [18]. Mohammadi., *et al*. [19] identified that among the priming treatments; the seeds which were primed with potassium nitrate showed the most standard qualities for all characteristics than control, improved germination rate and seedling dry weight by 28.3, 129.4 and 58.1 percent, respectively. Seed priming of soybean with KNO_3 significantly increased the pods number, seeds plant^{-1} and seed yield. On opposing, rate of emergence and time taken to germination were significantly influenced by seed priming (KNO_3 and KH_2PO_4) when compared with unprimed seeds [11]. Halo priming of sunflower hybrid significantly increase speed of germination and vigor under field conditions [20]. Seed priming of rice with nitrate salts [KNO_3 and Mg

$(NO_3)_2$] increased height of plant, no of leaves, leaf area, fertile tillers, grain yield and panicle quality. This may due to the fact that nitrate salts worked as crop growth regulator and translocate more photos-assimilates towards yield attributing parts and improve the final yield [21]. Treatment of seeds with KNO_3 significantly improved 1000 seed weight, seedling length, germination, dry weight of seedlings, seed vigour index-I and index-II, protein content and electrical conductivity over the control (unprimed) [22,23]. Priming of soybean seeds with KNO_3 increased the germination, emergence rate, dry weight, plant height, leaf area, plumule and radical length [23]. Priming of corn seeds with potassium nitrate increased germination percentage (93%), weight of tassel (4.3%), biological yield (33.2%), harvest index (10.4%), speed up germination, lessened time taken to emergence and inhibit the abiotic and biotic factors [24]. Priming of tomato seeds with KNO_3 increased maximum germination rate, the activity of nitrate reductase and antioxidant enzymes [25]. Priming of soybean seeds with $CaCl_2.2H_2O$ significantly increased plant height, branches number, pods number, seeds number per pods, and seed yield [26]. Priming of linola seeds with $CaCl_2$ increased plant height, tillers, branches, pods, seeds per pod, dry weight, fresh weight of seedlings, chlorophyll contents, crop branching and minimize flowering time. They also enhanced seed weight, biological yield and seed yield oil content and harvest index [27].

Osmo priming

Osmo priming is soaking of seeds prior to sowing in osmotic priming solutions (polyethylene glycol, sugar, mannitol and vermiculite compounds) for certain period time. Osmo priming has a positive effect on enhancement of seeds germination and seedlings growth, especially under stress conditions. Osmo priming increased salinity tolerance in sunflower, tomato and melon seeds [28]. Osmo priming of bitter gourd seeds is a help to technique overcame sub-optimal environmental conditions [29]. Osmo priming of rape seed significantly increased seedling height, radicle length, leaf number and dry weight as compared to un-primed seeds [30]. Priming of wheat seeds with PEG-8000 significantly increased seedling stand establishment [12]. Priming of bromus seeds with PEG improved seed germination, root length as compared to water and unprimed seeds [7]. Osmo priming of sorghum seeds significantly increased germination, plant height, emergence and dry matter accumulation as compared to unprimed [31]. Osmo priming of seeds positively affected germination and growth under stress conditions [32].

Solid matrix priming

Mixing of seed with water and solid material at specific proportions is known as solid matrix priming [33]. Most commonly used solid carriers are peat moss, vermiculite, charcoal, clay and sand. Solid matrix priming improved seed vigor and germination of soybean [34]. Solid Matrix priming of onion increased seed germination, growth and emergence under suboptimal and optimal conditions [35]. Sand priming increased α-amylase activity, membrane system integrity and emergence speed of corn cultivars [36]. Solid matrix priming with calcium aluminum silicate significantly increased seedling vigor, and fruit quality of okra [37].

Conclusion

Seed priming is an easy technique with a lot of benefits like fast emergence of seeds, enhances root growth, favors seed germination at various temperatures, helps to minimize the dormancy and plays a significant role in organic farming. So, priming may be considered as a best solution to overcome the germination problem.

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