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Research Paper

Seed hydropriming to overcome ageing damages in Coriander (*Coriandrum sativum* L.) seeds

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ABSTRACT

Seed priming is a physiological seed enhancement technique. Hydropriming method can advance germination under unfavorable conditions. The ability of hydropriming to mitigate ageing damage was evaluated in coriander. Seeds were subjected to accelerated ageing for 48 h at 42°C and thereafter hydroprimed at 20°C for 5, 10 and 15 h, respectively. Hydropriming significantly improved final germination percentage, germination rate, seedling length, vigour index, soluble sugars, total soluble proteins, catalase, superoxide dismutase and ascorbate peroxidase activities of aged seeds. Mean germination time, electrical conductivity and malondialdehyde content of primed seeds decreased in comparison to non-primed seeds. Hydropriming for 5, 10 and 15 h improved final germination percentage to 24.4, 40 and 95.5%, germination rate by 8.6, 29.3 and 41.4% and vigour index by 25.7, 70.7 and 166.8% as compared to non-primed seed, respectively. These results suggest that increased antioxidant enzyme activities affect germination performance of aged coriander seeds due to hydropriming for 15 h. In this study, aged coriander seeds were primed with distilled water in three durations. Some parameters such as germination percentage and rate, mean germination time, seedling length, vigour index, electrical conductivity, soluble sugars, total soluble proteins, malondialdehyde contents and antioxidant enzymes activities were evaluated for seed quality. Hydropriming improved the germination parameters of aged seeds. In comparison to non-primed ones, primed seeds were associated with a decrease in electrical conductivity, malondialdehyde values and an improvement of catalase, ascorbate peroxidase and superoxide dismutase activities and soluble sugars as well as, protein content. Therefore, hydropriming for 15 h could significantly mitigate the growth inhibition of aged coriander seed. It also protects morphological and physiological parameters from oxidative damage.

Key words: Ageing, catalase, coriander, hydropriming.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an annual and medicinal plant from Apiaceae family. This plant is native to South Western Asia and North Africa. Coriander is used as appetite stimulant, diuretic, anti-spasmodic, stomachic, anti-inflammatory and anti-diarrheic agent. Hydropriming has been developed as an essential method to enhance seed performance against aging damages (Yan, 2015).

It was reported that hydropriming is the low cost, quick, simplest, safest and effective method for increasing seed performance of some vegetables, including carrot, onion, tomato and napa cabbage (Matsushima and Sakagami, 2013; Yan, 2016).

The efficacy of hydropriming depends on priming duration, plant species and seed vigour (Ahmad and Lee, 2011). Yan (2016) stated that hydropriming increased germination percentage, germination potential, seedling vigour index and antioxidant enzyme activities of napa cabbage (*Brassica rapa*) cultivars. Amooaghaie (2011) reported that hydropriming could enhance germination and seedling growth in alfalfa grown under stress conditions. Ahmad et al. (2014) emphasized that hydropriming is the cheapest approach to hydrating seeds and minimizes the use of chemical agents. Sacala and Demczuk (2016) showed that hydropriming promoted the accumulation of both chlorophyll *a* and chlorophyll *b* as well as, activity of acid phosphatase in leaves of sugar beet (*Beta vulgaris*).

This research was carried out to investigate the effects of different priming durations on the germination characteristics of aged coriander seeds.

MATERIALS AND METHODS

Site description and plant material

This study was carried out at the Department of Agronomy and Plant Breeding, Faculty of Agriculture, Bu-Ali Sina University, Iran. Coriander seeds (Nahavand seed lot with initial moisture content 9.79%) were attained from Nahavand County (Hamedan Province).

Accelerated ageing test

Accelerated ageing was carried out at 42±1°C and 100% relative humidity for 48 h (Delouche and Baskin, 1973). Accelerated ageing duration was determined by preliminary experiment.

Seed priming

Coriander seeds were soaked in distilled water at 20°C for 5, 10 and 15 h under dark conditions. The hydroprimed seeds were surface-dried and dried back to their original moisture content at room temperature (26±2°C for 24 h) and calculated by changes in primed seed mass. Non-primed seeds were used as control.

Germination tests

Four replicates of 100 seeds were tested for germination between double layers of papers moistened with 15 ml of distilled water in 15 cm Petri dishes. Seeds were incubated in dark conditions at 20±1°C in 21 days. Seeds were considered to germinate when the radicle was 2 mm long (ISTA, 2007).

Measurements

Germination percentage was recorded every day until the final mentioned days. Mean germination time (MGT) was calculated by Ellis and Roberts's formula (1981) given as:

$$MGT = \sum Dn/n$$

Where n is the number of seeds, which germinated on day D and D is the number of days counted from the beginning of germination.

Germination rate (GR) was calculated by reversing MGT formula:

$$GR = 1/MGT$$

The seedling vigour index was calculated as (Sepehri and Rouhi, 2016):

$$VI = \sum(FGP \times SL)/100$$

Where VI is vigour index, SL is the mean of seedling length (cm) and FGP is final germination percentage.

The electrical conductivity (EC) test was measured according to the method described by Hampton and TeKrony (1995). After 21 days, seedlings were used to determine malondialdehyde (Cavalcanti et al., 2004), SOD activity (Giannopolitis and Ries, 1977), CAT activity (Cakmak and Horst, 1991), APX activity (Nakano and Asada, 1981), soluble proteins (Bradford, 1976) and soluble sugars (Irogoyen et al., 1992).

Statistical analysis

The experiment was a completely randomized design (CRD) with four replications. Data for germination percentage were arcsine transformed before analysis of variance. Statistical analysis was carried out using SAS 9.2 software. Mean comparison was performed with an LSD test if the F - test was significant at 5% probability level ($P < 0.05$).

RESULTS AND DISCUSSION

In preliminary experiment, the initial germination percentage, germination rate and seedling length of coriander seeds were 95.2%, 0.096 and 8.83 cm, respectively (data not shown). Table 1 shows that after accelerated ageing test, the final germination percentage, germination rate and seedling length diminished to 45%, 0.058 and 5.11 cm, respectively. All investigated traits were affected by hydropriming treatments (Table 1). Hydropriming decreased mean germination time, electrical conductivity and malondialdehyde content (Table 2).

Table 1: Analysis of variance for hydropriming treatment effects on germination traits of aged coriander seeds.

Source of variation	Degrees of freedom	Mean squares											
		FGP	**MGT**	**GR**	**SL**	**VI**	**EL**	**SS**	**TSP**	**MDA**	**CAT**	**SOD**	**APX**
Treatment	3	429.01**	8.79**	0.059**	14.02**	14.11**	25.98**	88.14**	12.30**	304.99**	0.005**	31.88**	0.012**
Error	8	9.02	0.027	0.0006	0.08	0.11	0.44	7.11	0.09	1.18	0.00002	0.39	0.00003
Coefficient of variation (%)	-	6.11	5.32	4.34	5.92	8.14	3.46	8.36	4.21	3.12	2.13	3.11	2.02

ns,**,* non-significant and significant at 1 and 5% of probability, respectively. **FGP:** Final germination percentage, **MGT:** Mean germination time, **GR:** Germination rate, **SL:** Seedling length, **VI:** Vigour index, **EC:** Electrical conductivity, **SS:** Soluble Sugars, **TSP:** Total soluble proteins, **MDA:** Malondialdehyde content, **CAT:** Catalase, **SOD:** Superoxide dismutase, **APX:** Ascorbate peroxidase.

Table 2: Mean comparison of hydropriming effect on germination characteristics of aged coriander seed.

Priming duration (h)	FGP (%)	MGT (day)	GR (day $^{-1}$)	SL (cm)	VI	EC (µS.cm^{-1}g^{-1})	SS (mg.[gdw]$^{-1}$)	TSP (mg.[gfw]$^{-1}$)	MDA (nmol.[gfw]$^{-1}$)	CAT (Units[mgpr]$^{-1}$)	SOD (Units[mgpr]$^{-1}$)	APX (Units[mgpr]$^{-1}$)
0	45^{d}	17.2^{a}	0.058^{d}	5.11^{c}	2.29^{d}	29.67^{a}	16.86^{b}	5.32^{d}	48.12^{a}	0.218^{d}	19.14^{b}	0.271^{c}
5	56^{c}	15.8^{b}	0.063^{c}	5.16^{c}	2.88^{c}	26.41^{b}	22.91^{b}	8.26^{c}	41.39^{b}	0.239^{c}	26.05^{a}	0.368^{b}
10	63^{d}	13.3^{c}	0.075^{b}	6.22^{b}	3.91^{b}	24.53^{c}	28.26^{a}	9.81^{b}	31.46^{c}	0.261^{b}	26.19^{a}	0.376^{b}
15	88^{a}	12.1^{d}	0.082^{a}	6.95^{a}	6.11^{a}	21.92^{d}	30.13^{a}	10.33^{a}	26.18^{d}	0.283^{a}	26.71^{a}	0.421^{a}

In each column means followed by the same letter are not significantly different at the $P < 0.01$ level. **FGP:** Final germination percentage, **MGT:** Mean germination time, **GR:** Germination rate, **SL:** Seedling length, **VI:** Vigour index, **EC:** Electrical conductivity, **SS:** Soluble Sugars, **TSP:**Total soluble proteins, **MDA:** Malondialdehyde content, **CAT:** Catalase, **SOD:** Superoxide dismutase, **APX:** Ascorbate peroxidase.

On the other hand, hydropriming increased germination percentage and rate, seedling length, vigour index, soluble sugars, total soluble proteins and antioxidant enzyme activities (Table 2). By increasing priming duration, final germination percentage and germination rate were significantly increased (Table 2). Hydropriming enhanced the germination percentage of napa cabbage seeds (Yan, 2016) and the germination rate of rice (*Oryza sativa*) seeds (Matsushima and Sakagami, 2012).

Lopez et al. (2016) showed that seed priming with distilled water increased germination synchrony and reduced the lag time for start of germination of *Dodonaea viscosa* seeds, thereby, successfully invigorating artificially aged seeds. Jisha et al. (2013) reported that hydropriming is a very important seed treatment technique for rapid seed germination and uniform seedling establishment in various grain crops. It was determined that hydropriming mitigated the adverse effect of abiotic stresses on amylase activity,

Thus, hydropriming may have significant beneficial effects on enzyme activity required for rapid seed germination (Ashraf and Foolad, 2005). Mean germination time was significantly decreased by increasing priming duration (Table 2). The lowest mean germination time value was detected after hydropriming for 15 h and the highest was observed in non-primed ones (Table 2).

Sallam (1999) reported that hydropriming of *Vicia faba* exhibited significantly lower germination time than those from non-treated seeds. He also reported that these effects correlated with increased amounts of total soluble sugars, lactose and maltose. Thornton and Powell (1992) determined that for seeds of Brussels sprouts (*Brassica oleracea*), hydropriming treatment at 25°C was the most effective for decreasing the time of germination, root growth, and seed vigor. The extended priming duration positively affected seedling length of aged seeds (Table 2). Seedling length increased significantly with an increase in the duration of priming from 5 to 15 h.

The improvement of seedling length through hydropriming is in line with the results obtained by Yan (2016), who reported that hydropriming enhanced seedling growth in two napa cabbage cultivars. Previously, Yan (2015) found that hydropriming treatment increased the germination rate and seedling dry weight of aged napa cabbage seeds. Andoh and Kobata (2002) explained that improvements in seedling emergence of rice (*Oryza sativa*) were due to enhanced supply of soluble carbohydrates to the the growing embryo, which was caused by an increase in a-amylase activity. The authors further speculated that redrying of seed following hydropriming did maintain activity of other enzymes at the levels required for occurrence of germination. Submersing seeds in water for 15 h caused a significant increase in the vigour index as compared to other priming durations and non-primed seeds (Table 2).

Sharma et al. (2014) noted that hydropriming improved the vigour index of okra (*Abelmoschus esculentus*) seeds. Matsushima and Sakagami (2012) demonstrated that hydropriming for 12 h enhanced seedling vigour of rice seeds under different soil moisture conditions. Electrical conductivity of seeds decreased after all priming durations (Table 2). Chiu et al. (1995) found that improved membrane repair in primed seeds might cause better performance of primed seeds as a result of lower leakage of electrolytes from the cells.

Fujikura et al. (1993) also indicated the positive effects of hydropriming on electrical conductivity of aged cauliflower (*Brassica oleracea*) seeds. Yan (2015) reported that seed ageing induces the accumulation of reactive oxygen species, which degrade or damage nucleic acids and hydropriming can reduce the negative effects by promoting expression of repair genes. Highest amount of soluble sugars in all hydropriming durations was for 15 h, which was not statistically different with 10 h but was higher than 5 h and non-primed seeds (Table 2).

Sallam (1999) demonstrated that presoaking treatment of *V. faba* seed with water resulted in significant increases in insoluble sugars. A decrease in α-amylase activity in deteriorated seeds decreases the breakdown of starch into sugars that are needed for embryo growth (Bailly, 2004). An increase in the activity of amylase and dehydrogenase enzymes was observed in primed seeds (Andoh and Kobata, 2002). Activity of these enzymes leads to an increase in soluble sugar content and in their transfer to the embryo (Andoh and Kobata, 2002; Bailly, 2004).

Yan (2015) stated that soluble sugars of napa cabbage seeds primed with water increased. Total soluble proteins in seedlings from primed seeds was higher than those of the non-primed, while malondialdehyde content of seedlings was lower than that of seedlings from non-primed seeds (Table 2). Hydropriming was very effective in the mobilization of compounds such as proteins, free amino acids, and soluble sugars from storage organs to growing embryonic tissues (Jyotsna and Srivastava, 1998). Lowered malondialdehyde and electrical conductivity of primed seeds were in line with previous studies (Abdulrahmani et al., 2007; Sepehri and Rouhi, 2016). Reduction in malondialdehyde content was detected by El-Araby and Hegazi (2004) in tomato hydroprimed seeds.

Kamithi et al. (2016) found several processes, including activation and synthesis of a number of antioxidant enzymes and nucleic acids, repair and build up, ATP synthesis and the cytoplasmic membrane repair during priming. Thus, during priming there is a reduction in the content of malondialdehyde. The maximum catalase activity was recorded in seeds hydroprimed for 15 h, which differed significantly from other treatments (Table 2).

Kibinza et al. (2011) emphasized that catalase is a key enzyme for repairing seeds during priming. Yan (2015) proposed that catalase activity was correlated with the improvement in germination of primed napa cabbage seeds. The activity of superoxide dismutase was induced by seed priming, but there was no significant difference among priming durations (Table 2). Xia et al. (2015) claimed that the main factor of enzyme activity improvement in oat (*Avena sativa*) seeds is reactive oxygen species (ROS) scavenged by superoxide dismutase enzyme in the mitochondria. Yan (2015) found that higher time of hydropriming (10 h), could increase superoxide dismutase activity and minimize aging resultant oxidative stress.

Dong et al. (2014), also reported improved superoxide dismutase activity in aged welsh onion (*Allium fistulosum*) seed as a result of priming. The highest ascorbate peroxidase activity was observed in 15 h which did differ significantly from other treatments (Table 2).

Results from various researches demonstrate that hydropriming is a benefit technique for enhancing the quality of aged seeds (Yan, 2015; Kamithi et al., 2016; Yan, 2016). Caseiro et al. (2004) suggested that hydropriming was the most effective method for enhancing germination traits of onion (*Allium cepa*) seed, especially when seeds are hydrated for 96 h as compared to 48 h. Also, Kaya et al. (2006) indicated that increased time of hydropriming resulted in higher cumulative germination in sunflower (*Helianthus annus*).

According to Sacala and Demczuk (2016), higher time of hydropriming enables seed cells to respond to very low levels of a stimulus in a more rapid and robust manner as compared to non-primed cells.

The results of this research showed that hydropriming improves the germination of coriander with higher antioxidant enzyme activities, soluble sugars and total soluble proteins of primed seeds than in those of non-primed. Priming duration had a significant effect on the investigated traits of coriander seeds, with the greatest improvement achieved for 15 h priming. Therefore, hydropriming for 15 h can be successfully applied to enhanced seed germination and seedling vigour of aged coriander seeds.

REFERENCES

Abdulrahmani B, Ghassemi-Golezani K, Valizadeh M, Feizi-asl V (2007). Seed priming and seedling establishment of barley (Hordeum vulgare L.). J. Food Agric. Environ. 5:179-184.

Ahmad G, Lee HC (2011). Response of sesame (*Sesamum indicum*) cultivars to hydropriming of seeds. Aust. J. Basic App. Sci. 1:638-642.

Ahmad KU, Rahman MM, Ali MR (2014). Effect of hydropriming method on maize (*Zea mays*) seedling emergence. Bangladesh J. Agric. Res. 39 1):143-150.

Amooaghaie R (2011). The effect of hydro and osmopriming on alfalfa seed germination and antioxidant defenses under salt stress. Afr. J. Biotechnol. 10:6269–6275.

Andoh H, Kobata T (2002). Effect of seed hardening on the seedling emergence andalphaamylase activity in the grains of wheat and rice sown in dry soil. Japan J. Crop. Sci. 71:220–225.

Ashraf M, Foolad MR (2005).Pre-sowing seed treatment a shotgun approach to improve germination, plant growth, and crop yield under saline and non-saline conditions. Adv. Agron. 88:223-271.

Bailly C (2004). Active oxygen species and antioxidants in seed biology. Seed Sci. Res. 14:93-107.

Bradford MM (1976). A rapid andsensitive method for the quantitation ofmicrogram quantities of protein utilizingthe principle of protein dye binding. Anal. Biochem. 72:248-254.

Cakmak I, Horst W (1991). Effect of aluminium on lipid peroxidation, superoxide dismutase, catalase and peroxidase activities in root tip of soybean (*Glycine max*). Plant Physiol. 83:463–468.

Cavalcanti FR, Oliveira JTA, Martins-Miranda AS, Viegas RA, Silveira JAG (2004). Superoxide dismutase, catalase and peroxidase activities do not confer protection against oxidative damage in salt-stressed cowpeas leaves. New Phytol. 163:563–571.

Chiu KY, Wang CS, Sung JM (1995). Lipid peroxidation and peroxide-scavenging enzymes associated with accelerated ageing and hydration of watermelon seeds differing in ploidy. Plant Physiol. 94:441-446.

Delouche JC, Baskin CC (1973). Accelerated ageing technique for predicting relative storability of seed lots. Seed Sci. Technol. 1:427-452.

Dong L, Haoz, Li Z, Wang Q (2014). Enhancement of welsh onion (*Allium fistulosum* L.) seed vigor by KNO3 priming. J. Agric. Sci. Tech. 16:1345-1353.

Ellis RA, Roberts EH (1981). The quantification of ageing and survival inorthodox seeds. Seed Sci. Technol. 9:373–409.

Fujikura Y, Kraak HL, Basra AS, Karssen CM (1993). Hydropriming, a simple and inexpensive priming method. Seed Sci. Technol. 21:639–642.

Giannopolitis C, Ries S (1977). Superoxide dismutase. I: occurence inhigher Plant. Plant Physiol. 59:309–314.

Hampton JG, Tekrony DM (1995). Handbook of vigourtest methods. The international Seed Testing Association, Zurikh.

Irogoyen JJ, Emerich DW, Sanchez-Diaz M (1992). Water stress induced changes in concentrations of proline and total soluble sugars in nodulated alfalfa (*Medicago sativa*) plants. Physiol. Plantarum. 84:55-60.

ISTA (2007). International Rules for Seed Testing. Seed Sci. Technol. 13:299–520.

Jisha KC, Vijayakumari K, Puthur JT (2013). Seed priming for abiotic stress tolerance: an overview. Acta Physiology Plant. 35:1381–1396.

Jyotsana V, Srivastava AK (1998). Physiological basis of salt stress resistance in pigeonpea (*Cajanus cajan* L.) - II. Pre-sowing seed soaking treatment in regulating early seedling metabolism during seed germination. Plant Physiol. Biochem. 25:89–94.

Kamithi KD, Wachira F, Kibe AM (2016). Effects of Different Priming Methods and Priming Durations on Enzyme Activities in Germinating Chickpea (*Cicer arietinum* L.). Am. J. Nat. App. Sci. 1(1):1-9.

Kaya MD, Gamze O, Atal M, Yakup C, Ozer K (2006). Seed treatments to overcome salt and drought stress during germination in sunflower (*Helianthus annuus* L.). Europian J. Agron. 24:291-295.

Kibinza S, Bazin J, Bailly C, Farrant JM, Corbineau F, EL-Marrouf Bouteau H (2011). Catalase is a key enzyme in seed recovery from ageing during priming. Plant Sci. 181:309-315.

Lopez LVP, Rodriguez AR, Coronado MES, Hernandez PEM, Segovia AO (2016). Effects of hydropriming treatments on the invigoration of aged *Dodonaea viscosa* seeds and water-holding polymer on the improvement of seedling growth in a lava field. Restoration Eco. 24 (1):61–70.

Matsushima K, Sakagami J (2012). Effects of seed hydropriming on germination and seedling vigor during emergence of rice under different soil moisture conditions. Am. J. Plant Sci. 4:1584-1593.

Nakano Y, Asada K (1981). Hydrogen peroxide scavenged by ascrobate-specific peroxidase inspinachchloroplast. Plant Cell Physiol. 22:867–880.

Sacala E, Demczuk A (2016). Effect of laser and hydropriming of seeds on some physiological parameters in sugar beet. J. Elementol. 21(2):527-538.

Sallam HA (1999). Effect of some seed-soaking treatments on growth and chemical components on faba bean plants under saline conditions. Ann. Agric. Sci. 44:159–171.

Sepehri A, Rouhi HR (2016). Enhancement of seed vigor performance in aged groundnut (*Arachis hypogaea* L.) seeds by sodium nitroprusside under drought stress. Philipp Agric. Sci. 99 (4):339-347.

Sharma AD, Rathore SVS, Srinivasan K, Tyagi RK (2014). Comparison of various seed priming methods for seed germination, seedling vigour and fruit yield in okra (*Abelmoschus esculentus* L. Moench). Sci. Hortic. 165:75-81.

Thornton JM, Powell AA (1992). Short term aerated hydration for the improvement of seed quality in *Brassica oleracea* L. Seed Sci. Res. 2:41–49.

Xia F, Wang X, Li M, Mao P (2015). Mitochondrial structural and antioxidant system responses to aging in oat (Avena sativa L.) seeds with different moisture contents. Plant Physiol. Biochem. 94:122-129.

Yan M (2015). Hydropriming promotes germination of aged napa cabbage seeds. Seed Sci. Technol. 43(2):303-307.

Yan M (2016). Hydro-priming increases seed germination and early seedling growth in two cultivars of Napa cabbage (*Brassica rapa* subsp. pekinensis) grown under salt stress. J. Horticl. Sci. Biotech. 91 (4):1-6.

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