



Hydropriming -a useful technique for seed invigoration in okra (*Abelmoschus esculentus*) and parsley (*Petroselinum crispum*)

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Abstract: Seed germinating ability and stand establishment determine the management options in crop production system. Physiological advancement of seeds through priming is a simple and cost-effective method to improve the germinability and stand of any crop. Studies were performed on seed invigoration through hydropriming at the division of PHT, SKUAST-Kashmir during the year 2016 to optimize the hydropriming duration for improved germination and seedling vigour of okra (Pusa sawani) and parsley (curly type). Freshly harvested seeds were soaked in normal water for varying durations (okra- 12, 18 and 24 h; parsley- 24, 48 and 72 h) at (25±2°C) and re-dried to original moisture content at room temperature. Fifty seeds of each treatment were cultured in 14.0 cm Petri dishes lined with 5 layers of moist blotting paper. Observations on various germination parameters were recorded at (25±2°C). Priming of okra seeds for 18 h resulted in highest FGP (85.7%), GE (66.5%), GI (36.7), SDB (29.1mg) and SVI (2.49) coupled with minimum values of T₅₀ (2.75 day) as well as MGT (2.38 day). However, the highest FGP (78.7%), GE (48.7%), SDB (3.13 mg), GI (12.8) and SVI (0.25) together with minimum T₅₀ (7.2 day) and MGT (6.5 day) in parsley was recorded with 24 h priming duration. As such priming duration of 18 and 24 hours at 25±2°C were found optimal for enhanced and rapid seed germination with vigorous seedlings.

Keywords: Hydropriming, Okra, Parsley, Seed germination, Seedling vigour

INTRODUCTION

Being a rich source of vitamins and other essential nutrients, vegetables play an important role in human diet. They also gave more farm income than other crops. However, uniformity and rapidity of seed germination and emergence are essential to increase quality and profitable yield (Cantliffe, 2003; Duman and Eşiyok, 1998) which can be achieved by using improved seed quality. Okra is a popular vegetable of the world which contains vitamin A and C and is a good source of iron and calcium but suffers from poor and uneven seed germination and field emergence (Pandita *et al.*, 2010). Parsley is an important green leafy vegetable of the family *Apiaceae* and widely used as garnish to boost flavor and look of a dish. It is packed with minerals and vitamins and also recognized as one of the functional food for its unique antioxidants and disease preventing properties. However, its seeds have shorter viable life and also take longer time to germinate, especially under unfavorable environmental conditions (Vural *et al.*, 2000). Seed priming i.e. controlled hydration of seeds by exposing them to low water potential and re-drying, to permit pre-germinative physio-biochemical changes to occur but restrict germination is a known technique for improved seed germination potential under normal as

well as stressful environments. The conventional way of seed priming has been to immerse them in an aerated solution of an osmotic material, usually polyethylene glycol (PEG) for a certain period of time and then re-drying to original moisture content. Hydropriming (HP) introduces normal liquid water to seeds in controlled and precise amounts to achieve a desired level of hydration (McDonald, 1999). HP has been proved as a useful technique in many crops for accelerating germination with improved seedling vigour (Huang *et al.*, 2002; Ghassemi-Golezani, *et al.*, 2010; Ogbuehi *et al.*, 2013). However, success of hydropriming depends on priming duration which varied widely from crop to crop (Ghassemi-Golezani, *et al.*, 2010; Khafagy, *et al.*, 2014). Further, information available on priming of vegetable seeds particularly okra and parsley are scanty. Hence the present work has been performed to optimize the priming duration for okra (Pusa sawani) and parsley (curly type) seeds and realize the benefits of hydropriming technique in terms of germination per cent, rapidity and seedling vigour.

MATERIALS AND METHODS

The experiments were performed at the Division of Post Harvest Technology, SKUAST-Kashmir, Shalimar (Srinagar) during the year 2016. The seeds of okra (cv. Pusa sawani) and parsley (curly type) were

obtained from the division of Vegetable Science, SKU-AST-Kashmir. Two independent experiments were organized one each for okra and parsley. Approximately 10.0 and 1.0 g of okra and parsley seeds were hydroprimed by soaking them in ten layers of blotting paper fully saturated with distilled water and kept in a BOD incubator for 12, 18 and 24 hours and 24, 48 and 72 hours, respectively at 25±2°C. Dry seeds without priming were taken as control. The seeds were surfaced sterilized in 1:10 (v/v) dilution of commercial hypochlorite bleach for 10 min and rinsed several times with distilled water. Fifty seeds of each treatment were cultured in 14.0 cm Petri dishes lined with 5 layers of moist blotting paper. The experiment was set in an incubator (25±2°C) following randomized block design (CRD) with four replications. Seed germination was recorded on daily basis according to AOSA (1990) until a constant count and final germination per cent (FGP) was calculated. Seeds were considered to have germinated after radicle emergence. The time taken to reach 50% germination (T₅₀) was calculated according to the formula of Coolbear *et al.* (1984) modified by Farooq *et al.* (2005): $T_{50} = t_i + [(N / 2 - n_i) (t_i - t_j)] / n_i - n_j$. Where, N is the final number of emergence and n_i, n_j cumulative number of seeds germinated by adjacent counts at times t_i and t_j, respectively when n_i < N / 2 < n_j. Energy of germination (GE) was calculated as percentage of seeds germinated at 3rd and 7th day (Bam *et al.*, 2006), respectively in okra and parsley. Seedling dry biomass (SDB) of 10 randomly selected seedlings was determined by drying the seedlings at 80 ±2°C for 48 hours. Mean germination time (MGT) was calculated according to the equation $MGT = \sum Dn / \sum n$ (Ellis and Roberts, 1981). Where n is the number of seeds, which were germinated on day D, and D is the number of days counted from the beginning of germination. The germination index (GI) was calculated by the equation $GI = G_1 / T_1 + G_2 / T_2$

+...+ G_n / T_n (AOSA, 1983). Where, G₁, G₂,..., G_n: number of germinated seed on the first count, second count, and so on until the last count (n), respectively, and T₁, T₂,..., T_n: number of days between sowing and the first count, between the sowing and the second count, and so on until the last count (n), respectively. Seedling vigour index (SVI) was calculated by multiplying the dry weight (g) of seedlings with germination percent (Abdul-Baki and Anderson, 1973). Statistical analysis was conducted using an analysis of variance followed by Tukey's test. A P-value of <0.05 was considered significant.

RESULTS AND DISCUSSION

Hydropriming resulted in noteworthy improvements in various germination parameters of okra which also differed significantly among the assorted priming durations (Table 1). The importance of early germination, seedling emergence and rapid stand establishment and growth is quite essential to compete for water, light and nutrients. HP of Pusa sawani okra seeds for 18 hours at 25±2°C resulted in highest FGP (85.7%), GE (66.5%), GI (36.7), SDB (29.1mg) and SVI (2.49) coupled with minimum values of T₅₀ (2.75 day) as well as MGT (2.38 day). The values obtained with 18 h HP were significantly superior (p=0.05) to all other treatments. HP for 12 hours was proved as the second best treatment in terms of FGP, T₅₀, GE, MGT, SDB) and SVI, however, the values were found at par with control (p=0.05). Increased priming duration for 24 hours exhibited poorest germination ability and produced significantly minimum values of FGP (70.8%), GE 48.8%) SDB (19.4mg) as well as SVI (1.37) associated with greater values of T₅₀ (3.15 day) an MGT 2.85 day).

Comparable to okra, hydropriming also improved germination potential in curly type of parsley seed and differed significantly due to duration of priming at 5

Table 1. Effect of hydropriming duration on seed germination attribute in okra

Treatments	FGP (%)	T ₅₀ (day)	GE (%)	MGT (day)	GI	SDB (mg)	VI
Control	76.5	3.10	55.4	2.85	31.6	20.8	1.59
12 hours	79.3	3.06	59.4	2.67	30.4	22.6	1.79
18 hours	85.7	2.75	66.5	2.38	36.7	29.1	2.49
24 hours	70.8	3.15	48.8	2.85	33.4	19.4	1.37
CD (p≤0.05)	4.3	0.37	5.3	0.17	2.5	3.5	0.32

FGP – final germination; T₅₀ – time taken to 50 per cent germination; GE – energy of germination (day 7th); MGT – mean germination time; GI – germination index; SDB – seedling dry biomass; SVI – seedling vigour index

Table 2. Effect of hydropriming duration on seed germination attribute in parsley.

Treatments	FGP (%)	T ₅₀ (day)	GE (%)	MGT (day)	GI	SDB (mg)	VI
Control	70.3	8.1	41.3	7.5	9.5	2.13	0.15
24 hours	78.7	7.2	48.7	6.5	12.8	3.13	0.25
48 hours	74.0	7.8	47.1	6.8	10.5	2.48	0.18
72 hours	66.5	8.5	40.2	7.7	9.6	1.97	0.13
CD (p≤0.05)	4.82	0.5	1.2	0.3	2.0	0.43	0.06

FGP – final germination; T₅₀ – time taken to 50 per cent germination; GE – energy of germination (day 7th); MGT – mean germination time; GI – germination index; SDB – seedling dry biomass; SVI – seedling vigour index

per cent level of significance (Table 2). Moreover, parsley seeds required prolonged duration of time for effective priming changes to occur in terms of seed germination potential. Seed HP for 24 hours was proved as the optimum priming duration in curly type of parsley which resulted in significantly highest FGP (78.7%), GE (48.7%), SDB (3.13 mg), GI (12.8) and SVI (0.25) together with minimum T_{50} (7.2 day) and MGT (6.5 day). Increased priming durations above 24 hours (i.e. 48 and 72 hours) were however proved detrimental to seed germination ability in parsley and even gone behind the unprimed dry seeds in extreme priming duration (72 hours). As evident from the data, seed priming for 72 hours in fact caused seed deterioration instead of invigorations and showed statistically ($p=0.05$) lowest FGP (66.5%), GE (40.2%), SDB (1.97mg), GI (9.6) as well as SVI (0.13) together with highest values of T_{50} (8.5 day) and MGT 7.7 day) followed in ascending order by unprimed dry seeds.

Abbasdokht *et al.* (2004) informed that high quality of germination in crops will result high yield. An improved germination of okra due to seed hydration-dehydration (priming) treatment has earlier been reported by Enu-Kwesi *et al.* (1986). Abbasdokht (2011) reported that hydropriming of wheat seeds (cv. Pishtaz) for 18 hours resulted in maximum germination percent, seedling biomass, root length, shoot length, germination index and seedling vigour index as compared to unprimed and haloprimered seeds under normal as well as stress environment. Caseiro *et al.* (2004) found that hydro priming was the most effective method for improving seed germination of onion. The improved seed germination of hydroprimed seeds may be attributed to the improved physiologically active state of pre-germinated seeds due to priming (Matsushima and Sakagami, 2013) as the metabolic process of seeds related to α -amylase activity is activated by water absorption with seed priming and the metabolic potential is preserved in the seed during the dry period after seed priming (Ando and Kobata, 2002). As such increased seedling growth with HP of seeds might be the result of increased supply of soluble sugars owing to the increase in activated α -amylase. It has also been shown that seed priming causes metabolic changes in germinating seed, such as cell cycle related events (De Castro *et al.*, 2000), endosperm weakening by hydrolase activities (Bradford *et al.*, 2000) and mobilization of storage proteins (Job *et al.*, 2000). However, positive effects of seed priming on seed invigoration depends on priming duration (Ashraf and Foolad, 2005; Ghassemi-Golezani *et al.*, 2008b). When seeds imbibe, the water content reaches a plateau and changes little until radicle emergence (Bradford, 1986). Priming up to this point can have a positive effect, while extended priming duration will negatively affect germination in tomato.

Conclusion

These results suggest that hydropriming is a good technique for germination improvement in okra as well as in parsley but proper priming duration is a key factor to ensure optimum and speedy germination with high seedling vigor. Priming duration of 18 and 24 hours at $25\pm 2^{\circ}\text{C}$ were found optimal for enhanced and rapid seed germination with vigorous seedlings in Pusa Sawani okra and curly type of parsley, respectively. Further, increase of hydropriming duration above optimum is not only uneconomical but also has detrimental effect on germination.

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