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Effect of hydro priming durations on germination response of aged tomato and brinjal seeds

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Abstract
Seed priming is an important technique used to enhance seed quality under normal as well as under stress conditions. Among several priming techniques, hydro priming is the easiest and the cheapest method to enhance seed quality parameters. In the present investigation we studied the effect of hydro priming durations on quality parameters of old vegetable seeds. One year old seeds of tomato and brinjal were soaked in water for 0, 6, 12, 18 and 24 hours. After completion of soaking period the seeds were dried under shade to regain the original weight. Observations were recorded on germination count, speed of germination, root length, shoot length, seedling length, seedling dry weight, seedling vigour index I and II. The experiment was conducted in CRD with four replications. Results revealed that 12 hours of hydro priming durations recorded the maximum germination count (83.0%), speed of germination (2.67), vigour index-I (833.75) and vigour index-II (933.75) in tomato. Hydro priming durations for 12 hours recorded the maximum germination (82.00%) and vigour index-II (1312) but 18 hours of hydro priming durations recorded the highest SV-I (354.13) in brinjal. Germination response to hydro priming durations in tomato and brinjal showed curvilinear relationship with respect.

Keywords: Hydropriming durations, germination, vigour index

Introduction
A high-quality seed ranks among the most crucial inputs in agriculture, essential for achieving increased crop yields. The significance of top-notch seeds has been particularly evident in recent advancements within Indian agriculture, serving as a driving force for unlocking the potential of all other agricultural inputs. During the storage period, seeds gradually degrade, moving inevitably towards a state of reduced viability followed by a decline in germination capacity. It would be highly beneficial for both the seed industry and the farming community to explore effective, cost-efficient methods for enhancing seed quality. Among several priming techniques, hydro priming is the easiest and the cheapest method to enhance seed quality parameters. Hydropriming is defined as a pre-sowing treatment involving controlled hydration of seeds. Hydration is sufficient to allow pre-germinative metabolic activation to take place, but insufficient to allow radicle protrusion through the seed coat (Nascimento and Aragao, 2004) [7]. According to Ashraf and Foolad (2002) [13], hydropriming improved the rates of water uptake and imbibition kinetics in aged seeds from different crop species. This indicates that hydropriming has a beneficial effect on physiological processes crucial for successful germination. Hydropriming was found to have a beneficial impact on the germination performance of watermelon according to Huang *et al*. (2002) [4]. Xiaoying *et al*. (2005) [12] noted that hydropriming could overcome germination barriers associated with the seed coat of triploid watermelon seeds.
Tomato (*Solanum lycopersicum* L.) is one of the most important edible and nutritious vegetable crop in the world. The demand for the crop is year round, owing to the versatility of its usages both in fresh and processed food preparation. It gains more popularity due to its antioxidant property. It is a very good source of vitamin A and C. Brinjal (*Solanum melongena* L.) is an important solanaceous vegetable of tropics and sub-tropics. Brinjal is a very low calorie vegetable and has healthy nutrition profile.

It contains good amount of many essential B-complex group of vitamins such as pantothenic acid (vitamin B5), pyridoxine (vitamin B6), thiamin (vitamin B1) and niacin (vitamin B3). Considering hydro priming as the cheapest and easiest method of improving seed quality we have undertaken this investigation to study response of aged brinjal and tomato seeds to different hydro priming durations.

Materials and Methods

The experiment was conducted at the Laboratory of Department of Seed Science and Technology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar. One year old tomato (Var. Utkal Deepti) and brinjal (Var. Utkal Anushree) seeds were soaked in distilled water at room temperature for 6, 12, 18 & 24 hours. After priming, the soaked seeds were removed and dried to regain original weight under shade. Then after 7 days these seed samples from the respective treatments were drawn and put for germination following petriplate method. Observations were recorded on ten randomly selected seedlings for quality parameters like seed germination (%), shoot, root and seedling length (cm), seedling dry weight (mg) and seedling vigour index I & II. The experiments were conducted following CRD with four replications.

Seed germination (%)

Germination test was conducted on pure seed fraction using 50 seeds in four replicates following petriplate method at normal room temperature. The numbers of normal seedlings were counted on 8th day (final count) of germination from all the replications. The average of four replications was expressed as germination percentage. The germination per cent was calculated based on the number of normal seedlings produced.

Germination % = (Number of germinated seeds)/(total number of seeds kept for germination) × 100

Seedling vigour index-I & II

SV-I = Seed germination (%) × seedling length (cm)
SV-II = Seed germination (%) × seedling dry weight (mg)

Results and Discussion

Effect of hydro priming durations on quality parameters of aged tomato seed

Effect of hydro priming durations on quality parameters of aged tomato seeds is presented in Table 1. Hydro priming durations had significant effects on all quality parameters of aged tomato seeds except shoot length. Final germination count at 0, 6, 12, 18 and 24 hours of hydro priming duration was 77.50%, 78.50%, 83.00%, 79.00% and 74.00% respectively. 12 hours of soaking period was found to record the maximum germination count and it was at par with 18 hours of hydro priming duration. All the treatments in tomato maintained the Indian seed certification standards (>70.00% germination count). Speed of germination (Table 1) was found to be the highest for 12 hours of priming durations (2.67) followed by 18 hours of priming durations (2.58).

The highest root length was observed at 12 hours of hydro priming duration (5.30 cm) and it was par with 18 hours of hydro priming duration. The highest shoot length was recorded at 12 hours of hydro priming duration (5.30 cm). This indicates that hydro priming has no significant effect on shoot length of tomato. Hydro priming for 12 h recorded the highest seedling length of 10.05 cm and it was at par with hydro priming for 18 hours (9.53 cm). The maximum seedling dry weight (11.75 mg) was observed at 18 hours of hydro priming duration and it was at par with all other treatments except control.

Hydro priming produced significant effect on seedling vigour index –I. Seed priming for 12 hours recorded the highest SV-I (833.75) and it was at par with seed priming for 18 hours. Hydro priming durations for 6 and 24 hours had no significant effect on seedling vigour index-I. Seed priming with water had significant effect on seedling vigour index-II. The maximum SV-II value was observed by hydro priming for 12 hours (933.75). All the hydro priming durations had higher SV-II value compared to control (756.00). This study reveals that hydro priming has positive influence on seed quality of tomato as compared to non primed seeds.

Table 1: Effect of hydro priming durations on seed quality parameters of tomato

Treatment	Germination %	Speed of germination	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling dry wt. (mg)	SV-I	SV-II
T_1 (Control)	77.50	1.41	4.03	4.45	8.83	9.75	683.20	756.00
T_2 (6 hrs)	78.50	2.08	4.20	4.63	8.48	10.50	664.65	824.00
T_3 (12 hrs)	83.00	2.67	5.30	4.75	10.05	11.25	834.15	933.75
T_4 (18 hrs)	79.00	2.58	4.88	4.65	9.53	11.75	752.75	928.00
T_5 (24 hrs)	74.00	2.33	4.53	4.50	9.10	11.00	672.42	812.50
CD (0.01)	4.23	0.24	0.52	NS	0.76	1.17	56.60	76.45
CV %	2.59	5.23	5.47	4.44	3.98	5.19	3.77	4.31

Response pattern of aged tomato seeds for final germination, SV-I and SV-II to hydro priming duration is depicted in Fig. 1. These figures described whether linear or curvilinear relationship exists between seed quality parameters and hydro priming durations. It was observed from the graphs that curvilinear relationship fits best to the experimental data rather than the linear relationship. The coefficient of determination (R^2) value in case of curvilinear regression equation was higher and approached to unit than the linear regression equation for the quality parameters like final germination. The R^2 value in case of curvilinear regression equation and linear regression equation was 0.821 and 0.101 for final germination. This result indicates no linear relationship between hydro priming duration and germination count in case of aged tomato seeds.

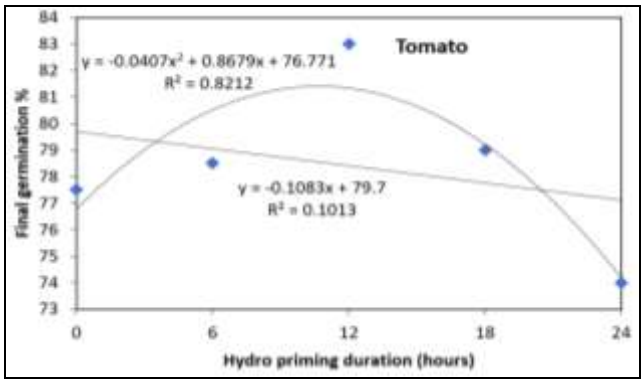

Fig 1: Regression equations between priming duration and final germination count in tomato

Effect of hydro priming durations on quality parameters of aged brinjal seeds

Analysis of variance showed significant difference among the hydro priming durations for all seed quality parameters except seedling length and seedling dry weight in brinjal (Table 2). Final germination count varied from 73.20 to 82.00%. Hydro priming duration for 12 hours recorded the maximum final germination count (82.00%) and it was at par with 6 hours (78.66%) and 18 hours (77.66%) of priming durations. Speed of germination was the highest for 6 hours of priming durations (5.63) followed by 12 hours of priming durations (4.25).

Root length of different treatments ranged from0.88 to 1.62 cm (Table 2). Shoot length in brinjal was found to decrease with the increase in hydro priming durations. The maximum shoot length was exhibited for 6 hours of priming duration (3.26 cm) and it was significantly higher than all other hydro priming durations and at par for 0 hour of priming duration (3.23 cm). Hydro priming durations did not affect seedling length in brinjal. The maximum seedling length was observed for 24 hours of priming duration (4.52 cm). Seedling dry weight was also not influenced by hydro priming durations and it varied from10 to 16 mg/seedling. The maximum seedling dry weight (16 mg) was recorded for 12 hours of seed priming with water followed by 6 hours of priming duration (14 mg). The minimum was recorded in case of control.

Seedling vigour index-I of different treatments is presented in Table 2. Significant difference was noted for different hydro priming durations. SV-I value for 0, 6, 12, 18 and 24 hours of priming duration was 300.85, 348.26, 347.68, 354.13 and 339.00. Hydro priming for 18 hours recorded the highest SV-I value (354.13) and it was at par with 6 and 12 hours of priming durations (348.26; 347.68).SV-II value for 0, 6, 12, 18 and 24 hours of priming duration was 732, 1101, 1312, 1243 and 975. Hydro priming for 12 hours recorded the highest SV-II value (1312) and it was at par with 6 and 18 hours of priming durations (1101; 1243). This study reveals that hydro priming duration has certain effect on seed quality parameter of aged brinjal seeds.

Table 2: Effect of hydro priming durations on quality parameters of aged brinjal seeds

Treatment	Final germination %	Speed of germination	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling dry wt. (mg)	SV-I	SV-II
T_1 (Control)	73.20	3.27	0.88	3.23	4.11	10.0	300.85	732
T_2 (6 hrs)	78.66	5.63	1.16	3.26	4.42	14.0	348.26	1101
T_3 (12 hrs)	82.00	4.25	1.21	3.03	4.24	16.0	347.68	1312
T_4 (18 hrs)	77.66	3.42	1.62	2.81	4.43	11.0	354.13	1243
T_5 (24 hrs)	75.00	3.09	1.55	2.97	4.52	13.0	339.00	975
CD (0.01)	5.29	1.03	0.67	0.19	NS	NS	10.46	53.4
CV %	4.28	4.27	5.18	4.82	3.74	4.53	5.31	3.88

The relationship between hydro priming durations and germination count in brinjal is shown in Fig. 2. The relationship was established through regression equations. Regression analysis following quadratic (polynomial) equations showed curved line where as linear equation showed a straight line. Our experimental data showed a good fit to curved line and did not fit to straight line in case of final germination %.The coefficient of determination (R^2) for polynomial and linear equation was 0.899 and 0.014 in case of final germination count. This clearly shows that final germination count has curvilinear relationship with hydro priming durations. In case of SV-I parameter the coefficient of determination (R^2) for curvilinear response was 0.907 and linear response was 0.366. Hence curvilinear response was more appropriate than linear response. In case of SV-II parameter the coefficient of determination (R^2) for curvilinear response was 0.996 whereas for linear response it was 0.185.Therefore it may be concluded that hydro priming durations had a curvilinear relationship with final germination, SV-I and SV-II parameters in case of aged brinjal seeds.

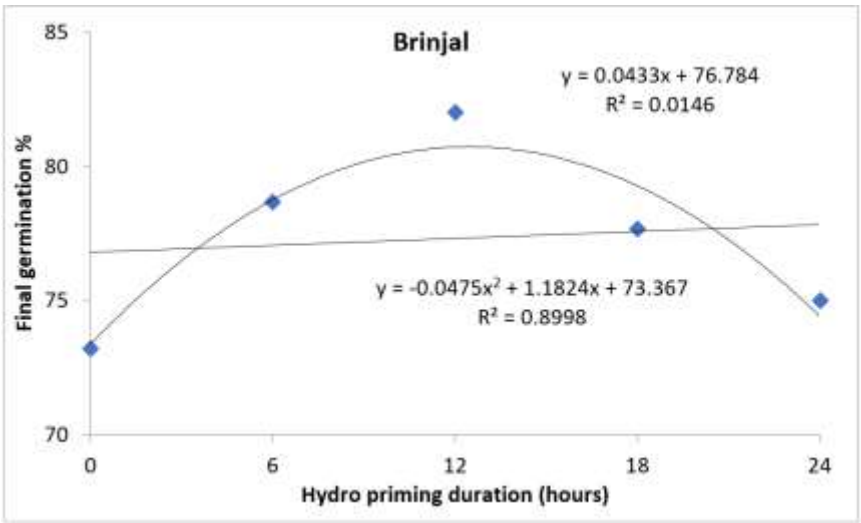

Fig 2: Regression equations between hydro priming duration and final germination in brinjal

Hydro-priming improves the water uptake efficiency and seed hydration under water stress conditions (McDonald, 2000) [6]. Filho and Kiti (2008) [3] suggested that hydropriming can promote speed of germination and speed of seedling emergence but have no effect on yield of cauliflower. Singh *et al.* (2011) [10] noted that under laboratory and greenhouse conditions, the

hydropriming treatments applied to cowpea seeds outperformed the untreated seeds in terms of seed germination, emergence, and growth three weeks after planting. Patel *et al*. (2017) [8] reported that hydropriming led to enhancements in germination percentage, germination index, mean germination time, seedling vigor index, and seedling growth when compared to untreated seeds in tomato and brinjal. Numerous scientific investigations have demonstrated that, in situations of drought stress, hydro-priming enhances germination and the growth of seedlings by three to four times when compared to not employing priming (Kaur *et al*., 2002) [5]. In our investigation it was observed that hydro priming had a positive effect on seed germination and seed vigour. Many studies have reported that hydropriming of seeds improved the seed germination in faba bean (Damalas *et al*., 2019) [2], okra (Raza *et al*., 2020) [9], bitter gourd (Tania *et al*., 2019) [11], brinjal (Patel *et al*., 2017) [8].

Conclusion

From this present investigation it may be concluded that hydro priming has significant effect in improving quality parameters of aged tomato and brinjal seeds. The optimum hydro priming durations for both tomato and brinjal is 12 hours.

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