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Influence of hydropriming on seed germination and seedling growth of bitter gourd (*Momordica charantia* L.)

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Abstract
Investigation was carried out to study the effect of different duration of hydropriming treatements on seed germination and seedling growth of bitter gourd. The experiment was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University by adopting Completely Randomised Block Design comprising of seven treatments (0, 6, 12, 18, 24, 36 and 48 hours of seed priming) replicated thrice. Among the different durations of hydropriming studied, seed priming with water for a duration of 48 hours recorded more water imbibition rate, germination percentage, seedling vigour index I and II. The seedling parameters like root length, shoot length, seedling length, seedling fresh and dry weight was found to be more in seeds primed in water for duration of 48 hours.

Keywords: bitter gourd, priming, germination, seedling fresh and dry weight

Introduction

Bitter gourd (*Momordica charantia* L.) usually called Karela or balsam pear belongs to family Cucurbitaceaeis a monoecious annual crop having epigeal germination. The plant requires a warm and hot climate and grows well on sandy loam soil with pH 6.0 to 6.7, and altitude range up to 1000 m with optimal germination and growth at the temperature range of 25-28˚C and 24-27˚C respectively. The crop is of high nutritional and medicinal importance. Its immature fruit is a rich source of dietary fibres, minerals, and Vitamins (C and A) which also acts as a blood purifier and is highly beneficial to diabetes patients. Each 100 g of edible portion of bitter gourd fruit contains 2.1g protein, 1.0g fat, 1.4 g minerals, 1.7 g fiber, 10.6 g carbohydrate, 23 g calcium, 38 g phosphorus, 2.0 g iron, 126 µg carotene, 0.07 mg thiamine, 0.06 mg riboflavin and 96 mg vitamin (Gopalan *et al*., 1989) [7]. Likewise, it also has anti-carcinogenic properties and can be used against multiple cancer forms as a cytostatic agent. Moreover, it is also used in traditional medicine to correct disorders like hyperlipidemia, digestive disorders, menstrual problems, and several microbial infections. Uniform and rapid germination is an important factor contributing to yield, quality, and ultimately the profit to the vegetable farmers. Because of the thick seed coat, the seed consumes water gradually resulting in sluggish germination and hence field emergence is always a problem in bitter gourd, even with the seed having high germinability. To overcome this problem, several techniques have been practiced and priming is one of them. Priming is a technique in which seeds are presoaked before planting to enhance germination. The benefits of priming include activation of enzymes, softening of seed coat, breaking of seed dormancy. Priming decrease the time necessary for germination (Nawaz *et al*., 2013) [13]. Seed priming is a simple, low-cost, and effective strategy for enhancing crop performance. It is described as a physiological approach that involves hydration and drying of seeds to improve the pre-germinative metabolic process without radicle protrusion in water or solution of other priming agents. Many agricultural and horticultural crops have been shown to benefit from it in terms of seed germination and seedling establishment and ultimately the productivity. Pre-sowing seed treatments resulted in higher germination and earlier seedling emergence, strong growth, early flowering, maturity, and high yields. Early and uniform germination by break down of photo and thermodormancy with extended germination temperature range, higher nutrient uptake, and improved water use efficiency have all been described as advantages of seed priming. It effectively improves seed vigour and germination, which is a complicated agronomic feature influenced by various genetic and environmental factors. So, it has long been described as a potential way to promote crop performance. Primed seeds also show a higher germination rate and better uniformity in emergence of seedlings which contribute to the regular establishment of crops and hence the yield. The fast growth of primed plants is related to better plant water status regulation and an increased nutrient usage capacity.

Hydro-priming is an economic and eco-friendly technique that is done by soaking seeds either in hot or in cold water for a certain period before sowing seeds in the field or any growing/nutrient media. This facilitates water imbibition in seed and makes seed coat soft enough for enhanced easy and fast growth of seed embryo. Moreover, the effective hydropriming of seeds is done by soaking of seeds in water cold, hot or normal for different duration before sowing in the field. Thick seed coat enclosing embryo affect germination by imposing mechanical restriction on embryo growth. This problem of poor or slow seed germination can be solved through many techniques and one of them is seed priming (Pandita and Nagarajan, 2007) [14]. Seed priming reduces the germination time, increases germination percentage, seedling emergence, and increases uniformity under adverse environmental conditions. Soaking duration and water temperature may vary depending on the type of seeds. Treated seeds show earlier germination and further growth whereas untreated seeds give late germination, smaller size plant, lower number of branching, late flowering, late fruiting, etc. being vulnerable to pathogen attack. Through water treatment of seeds the pathogenic structures can be washed out. However, there is a lack of proper information on the exact duration of the seed hydro-priming, especially for the bitter gourd. Therefore, the present study was undertaken to investigate the influence of hydro priming on seed germination and seedling growth of bitter gourd (*Momordica charantia* L).

Materials and Methodology

Experiment details

The experiment was conducted in Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar. Bitter gourd seed of local variety was used for the study. The experiment was conducted in Completely Randomised Block Design with seven different treatments of hydropriming duration replicated thrice. The treatment details are as follows

Table 1

T_1	-	Control (No hydropriming)
T_2	-	6 hours of seed hydropriming
T_3	-	12 hours of seed hydropriming
T_4	-	18 hours of seed hydropriming
T_5	-	24 hours of seed hydropriming
T_6	-	36 hours of seed hydropriming
T_7	-	48 hours of seed hydropriming

Seed priming

Totally 70 seeds were taken and they were primed with 100 milliliters (ml) of tap water by placing them in petri dish. For each treatment 10 seeds were soaked for a particular duration of time varying according to the treatments at room temperature (25±2˚C) and 90±3 per cent relative humidity**.** Then the soaked seeds were shade dried for 4 hours and sown in the prepared tray.

Seed sowing

Plastic tray with dimension 30 cm x 25 cm x 6 cm was taken for sowing the soaked seeds. The trays were filled with 1:1:1 (Red soil: FYM: Sand) of growing media. 10 seeds were sown in each treatment plot (in 7 rows each with 10 plants) at depth of 2.0 cm. And then the tray was covered with fine sandy soil. The seeds must be maintained at upright position in order to enable germination and the trays were shifted to seed germinator maintained at 25±2 °C temperature and 90±3 per cent relative humidity. After 14 days final count was recorded. Irrigation was given immediately after sowing with care. Irrigate the tray before dibbling the seeds and thereafter once a week.

Observations recorded

Five plants from each plot were selected randomly and tagged. These plants were used for recording all biometric observations at different stages of crop growth. The following biometric observations *viz*., water imbibition (%), germination (%), root length (cm), shoot length (cm), seedling length (cm), seedling fresh and dry weight (gm) and vigour index were recorded.

Statistical analysis

The analysis was carried out in a personal computer based DSAASTAT package. For treatments showing significance, critical differences were worked out at five percent probability level.

Results and discussion

Priming also enhances the activities of anti-oxidative enzymes in treated seeds (McDonald, 1999; Wang *et al*., 2003) [11, 19]. Moreover, priming increases the activities of glyoxysome enzymes in primed bitter gourd seeds (Mehta, 2014) [12]. Hydropriming is a very simple, economic and environmental friendly type of seed priming (Jamil *et al*., 2016) [9]. After all, the plants produced from untreated seeds gave poorer result than the plants of any treated seeds, either normal water, cool water or hot water. The induction of membrane integrity and quantitative changes of seeds biochemical content is due to priming. During seed germination, the physiological activities are also enhanced because of priming. Also, rehydration causes early germination because all pre-germinative processes have already been occurred (Ayaz *et al*., 2019) [4].

Seed germination parameters

Analysis of data obtained from various treatments revealed that T_7 (48 hours of seed hydropriming recorded more water imbibitions (45.86 %), high germination percentage (85.50 %) and more vigour index I (1365.44) and vigour index II (81.23) (Table.2). The result showed significant variations in bitter gourd by seed hydro-priming. The water imbibition increased with increasing hydro-priming durations. There was a significant difference in increasing hydro-priming durations initially but no significant difference was found after 36 hours of hydro-priming. In 48 hours of seed hydro-priming of bitter gourd had excelled other treatments by recording the water imbibition and germination percentage. This was followed by the treatment 36 hours of seed hydro-priming of bitter gourd. The possible fact for better percent germination by priming may be that it stimulates series of biochemical change in the seed that are essential to initiate the emergence process like break down dormancy, hydrolysis, metabolism of growth inhibitors, imbibitions, activation of enzymes (Ajouri *et al.*, 2004; Farooq *et al.*, 2009; Pukacka and Rajajczak, 2005) [2, 6, 16]. Variations among cultivars may be attributed to genetic potential of the cultivar. The reason for increased germination with increase in dipping duration is because of that each specie needs an optimum level of water in germination lag phase where all pre-germinative processes taken place (Pazdera and Hosnedl, 2002) [15]. The bitter gourd seed coat is very hard and hence took more time to soften the seed coat for germination that results in delayed emergence. Pre-sowing hydro-priming of seed facilitates in softening of seed coat and facilitates the biological process required for germination thereby resulting in early germination. Additionally, it also attenuates initial imbibition variations between the plants, resulting in more uniform germination. So, the germination percentage increases as it also do the time of soaking in water. The result is in parallel with those obtained on different crops. The resulting improvement in germination could be due to stimulation of important biochemical adjustments to render seeds ready for radicular protrusion: breakdown of dormancy, hydrolysis, growth inhibitor metabolism, embedding, and enzyme activation. In terms of metabolic and enzymatic repair and recovery of cellular membranes in aged seeds during imbibition, the benefit of bitter gourd seed soaking in tap water is provided, which enables osmotic changes to increase germination. Besides, the thick seed coat is conducive for softening, thereby raising the mechanical restriction influencing embryo development. Early germination and emergence of seeds lead to the rapid growth of seedlings making seedlings taller. Plants produced from primed seeds grow faster than those produced from non-primed plants leading to more height of seedlings. (Adhikari *et al.*, 2021) [1]. Increased hydro-priming durations are attributed to increased seedling vigour index I and II. The seedling vigor index is growing due to reduced imbibition lag time for priming treatments. Similar results were reported during the study of germination and field performance of vegetables; faba bean, bitter gourd, cucumber, and food crops. Priming often induces physiological and biochemical seed modifications during seed treatments and increased amylase production enhance metabolic tasks, resulting in higher seed vigor. Hydro-priming results in the better establishment of the plant root system which is indirectly related to fast growth and improved nutrient absorption that leads to taller plants and higher accumulation of dry matter. (Adhikari *et al.*, 2021) [1].

Table 2: Influence of hydro priming on water imbibition (%), germination percentage and seedling vigour index of bitter gourd (*Momordica charantia* L)

S. No	Treatments	Water imbibition (%) by seeds	Germination (%) of seeds at 14 DAS	Seedling vigour index (SVI)	
				SVI-I	SVI-II
1	T_1- Control (No hydro-priming)	0.00	65.00	894.6	49.8
2	T_2- 6 hours of seed hydro-priming	18.31	80.00	1101.59	63.0
3	T_3- 12 hours of seed hydro-priming	30.26	81.50	1155.97	66.10
4	T_4- 18 hours of seed hydro-priming	37.31	82.00	1210.32	69.7
5	T_5- 24 hours of seed hydro-priming	41.16	83.50	1301.77	75.15
6	T_6- 36 hours of seed hydro-priming	44.21	84.00	1322.16	78.12
7	T_7- 48 hours of seed hydro-priming	45.86	85.50	1365.44	81.23
	S.Ed	0.90	2.06	27.31	1.63
	CD(p=0.05)	1.79	4.11	54.62	3.25

Seedling growth parameters

The results of the present investigation revealed that there was significant difference between the treatments on the seedling parameters *viz.*, shoot length, root length, seedling length, seedling fresh weight, seedling dry weight, seedling vigour index (Table.3. & 4.). The maximum values for the above said seedling parameters were recorded in the tray 48 hours of seed hydro-priming. This treatment was closely followed by the treatment 36 hours of seed hydro-priming and found to be on par with the best treatment. The beneficial effect of priming on plant growth can be attributed to better root development and consequently the increased nutrient usage capacity that allows for a higher relative growth rate and better plant water status regulation. Higher growth of seedlings from primed seed can also be considered with the direct effect of pretreatment on the control of the cell cycle and the mechanisms of cell elongation. As one of the treatments gave most vigorous seedling, obviously it gave better result of shoot length, and good performance of other growth parameter like root length etc. The influence of pre-sowing treatments using hydropriming, osmopriming and halopriming in laboratory and/or nursery tests on seedling emergence, seedling weight and plant growth of endive and chicory are satisfactory (Ashraf and Falood, 2005) [3]. Priming stimulates series of biochemical change in the seed that are essential to initiate the emergence process like break down of dormancy, hydrolysis, metabolism of growth inhibitors, imbibitions, activation of enzymes (Ajouri *et al.*, 2004; Farooq *et al.*, 2009; Pukacka and Rajajczak, 2005) [2, 6, 16]. Soaking stimulates and produces enzymes like amylase and lipase which activate storage materials in seeds and mobilize anti-oxidant enzymes which subordinate per oxidation in seeds that retain seed vigour causing earlier emergence. Rehydration causes early emergence by influencing pre-germinative processes for germination (Farooq *et al.*, 2009) [6]. Pre-sowing treatments in raya seeds encourage growth of crop, reduced days to emergence, (Ullah *et al.*, 2012) [18]. In this study, treated seeds gave healthy vigorous seedling.

A range of crop species showed faster germination, early emergence and vigorous seedlings achieved by soaking seeds in water for same time followed by surface drying before sowing, which may result in higher crop yield (Harris *et al*., 2000) [8]. Seedling vigour means how fast a seedling can grow avoiding all adverse condition. It is count by normal seedling in comparison to total seedling. Good quality seeds give vigorous seedling. Sometimes it happens that, a seed plot may give better germination but normal seedling is very few in number. Seeds treated with both normal water and hot water at different duration showed more vigorous seedlings than untreated seeds. Tania *et al*. (2019) [17].

Table 3: Influence of hydro priming on shootlength root length and seedling length of bitter gourd (*Momordica charantia* L)

S. No	Treatments	Shoot length (cm)	Root length (cm)	Seedling length (cm)
1	T_1- Control (No hydro-priming)	7.59	5.25	12.84
2	T_2- 6 hours of seed hydro-priming	8.12	5.64	13.76
3	T_3- 12 hours of seed hydro-priming	8.31	5.81	14.14
4	T_4- 18 hours of seed hydro-priming	8.80	5.96	14.76
5	T_5- 24 hours of seed hydro-priming	9.28	6.31	15.59
6	T_6- 36 hours of seed hydro-priming	9.34	6.40	15.74

7	T_7- 48 hours of seed hydro-priming	9.45	6.52	15.97
	S.Ed	0.22	0.14	0.32
	CD(p=0.05)	0.43	0.64	0.64

Table 4: Influence of hydro priming on seedling fresh weight and seedling dry weight of bitter gourd (*Momordica charantia* L)

S. No	Treatments	Seedling fresh weight (gm)	Seedling dry weight (gm)
1	T_1- Control (No hydro-priming)	0.738	0.723
2	T_2- 6 hours of seed hydro-priming	0.828	0.775
3	T_3- 12 hours of seed hydro-priming	0.884	0.812
4	T_4- 18 hours of seed hydro-priming	0.936	0.847
5	T_5- 24 hours of seed hydro-priming	1.286	0.897
6	T_6- 36 hours of seed hydro-priming	1.336	0.926
7	T_7- 48 hours of seed hydro-priming	1.381	0.951
	S.Ed	0.03	0.02
	CD(p=0.05)	0.06	0.04

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