

Original Research Article

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Standardization of Hydropriming Duration and its Effect on Physiological Parameters of Spinach (*Spinacea oleracea* L.)

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ABSTRACT

Keywords

Germination, Hydropriming, Mean germination time, *Spinacea oleracea*, Vigour

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Seed germination and subsequent seedling growth define crucial steps for entry into the plant life cycle and proper seed germination is a basic pre-requisite for getting a better crop yield. Hence standardization of hydropriming duration in spinach seeds is an important pre-requisite to improve physiological and biochemical parameters, therefore seeds were soaked in different time intervals from 12, 16, 20, 24, 28 and 32 hours. Seeds soaked in water for 24 hours improved seed quality parameters over control, where germination increased to 94.25 per cent in seeds soaked in 24 hours.

Introduction

Spinach (*Spinacia oleracea* L.) is an edible flowering plant in the family Amaranthaceae. It was long considered to be in the family Chenopodiaceae, but in 2003, that family was merged into the family Amaranthaceae in the order Caryophyllales. Within the family Amaranthaceae, spinach belongs to subfamily Chenopodioideae. Spinach is most probably a native of central and western Asia region. It was known in China as early as 647 AD. Spinach, swiss

chard and garden beet has a chromosome number $2n=2x=24$, indicates their close relationship. Leaves of this crop might have been first used in Bengal and hence it is known as *Beta vulgaris* var. *bengalensis*. Spinach is one of the most common leafy vegetables of tropical and subtropical regions. The popular spinach growing states include Uttar Pradesh, West Bengal, Maharashtra and Gujarat. However, spinach is not very popular in South India. It is primarily used as pot herb and is a rich Source of vitamin A and C and also contains appreciable amount of protein,

calcium and iron. The leaves contain low oxalic acid.

Cultivation of spinach is carried out in cooler regions as it requires about 15-20 °C temperature for flowering and seed production. It tolerate frost and high temperature under good irrigation. Under high temperature conditions, early bolting occurs and leaves pass edible stage quickly with poor yield. Though spinach can be grown on a wide range of soils, well fertile, sandy loams soil with good drainage is ideal. Spinach is tolerant to slightly alkaline soils and is highly tolerant to salts also. One of the simple techniques which can improve seedling vigour and establishment is seed priming (Khan *et al.*, 2005). Priming is a pre-sowing seed treatment which permits early DNA replication, increase RNA and protein synthesis, repairs deteriorated seed parts and reduces the leakage of metabolites thus enhances the embryo growth, speed and uniformity of seedlings in field. Primed and dried seeds normally have a more rapid and uniform germination when subsequently re-hydrated, especially under adverse environmental conditions.

An important problem encountered in the cultivation of spinach is the poor germination of the seeds when planting is done in extremely warm temperatures, which may delay or inhibit seed germination in the field, reduce uniformity total stand establishment and ultimately reduces the yield. Hence standardization of duration for hydropriming to obtain better crop stand could be an attractive approach in spinach.

Materials and Methods

The laboratory experiments of present investigation on “Standardization of hydropriming duration and its effect on physiological and biochemical parameters of

spinach (*Spinacia oleracea* L.)” was carried out during 2017-2018 in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur. The details of the materials used and methods adopted during the course of the investigation are presented. Geographically, the station is situated in the North-Eastern dry zone (Zone-2) of Karnataka State at 16° 15' North latitude and 77° 20' East longitude and at an altitude of 389 meter above mean sea level. Fresh seeds of spinach variety “Annapoorna” were obtained from University of Horticultural Sciences, Bagalkot. The Annapoorna is an improved spinach variety with test weight of 10 - 12 g which matures in 150- 180 days. Spinach crop can be grown on a wide range of soils provided that soils are sufficiently fertilized and well drained.

The experiment was laid out in CRD (Completely Randomized Design) with three replication and the seeds were soaked in water at respective duration with the difference of 4 hours interval and following observations were made.

Results and Discussion

In the present investigation, the spinach seeds were soaked in water for different durations *viz.*, 12, 16, 20, 24, 28 and 32 hours and the seeds were evaluated for seed quality parameters.

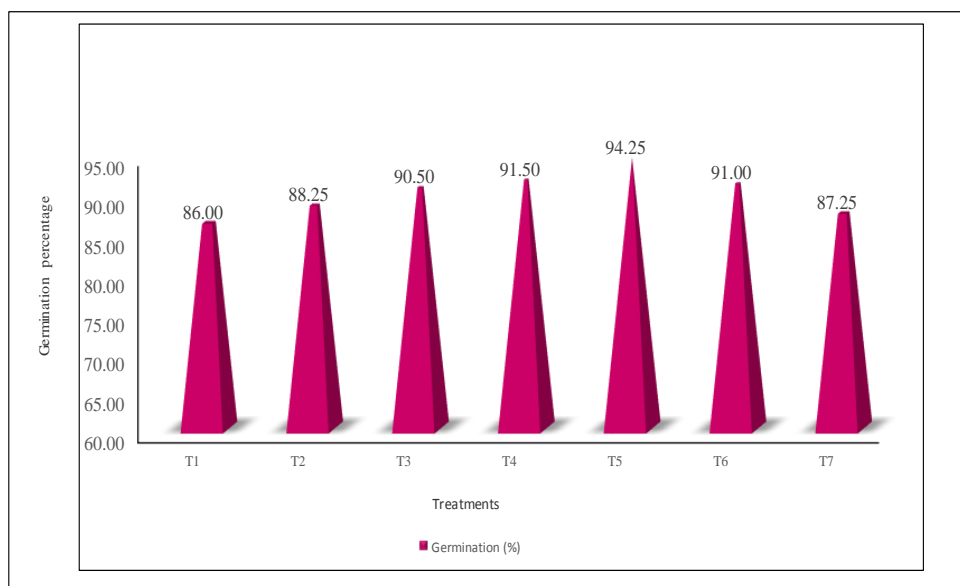
The seeds hydro primed for 24 hours recorded significantly maximum germination (94.25%) (Fig. 1a), speed of germination (34.83) (Fig. 1b), root length (5.79 cm), shoot length (7.10 cm), seedling dry weight (19.26 mg), seedling vigour index (1287), germination rate index (3586), peak value of germination (19.26), low mean germination time (2.24) and low electrical conductivity (0.339 dsm⁻¹) followed by priming duration of 20 hours (91.5%,

33.59, 5.79 cm, 7.10 cm, 18.46 mg, 1179, (86.00%, 28.84, 5.16 cm, 6.25 cm, 16.03 mg, 3490, 18.47, 2.58 and 0.446 dSm⁻¹, 981, 2908, 15.59, 3.19 and 0.733 dsm⁻¹, respectively). However, the lowest seed quality parameters were recorded in control

Table.1 Effect of hydropriming durations on physiological and biochemical parameters of spinach

Treatments	Root length (cm)	Shoot length (cm)	Seedling vigour index	Seedling dry weight (mg)	Germination rate index	Peak value of germination	Mean germination time	Electrical conductivity (dSm ⁻¹)
T₁- Control	5.16	6.25	981	16.03	2908	15.59	3.19	0.733
T₂- 12 hour	5.48	6.51	1058	16.84	3066	16.80	2.92	0.656
T₃- 16 hour	5.53	6.85	1120	17.64	3226	17.77	2.76	0.547
T₄- 20 hour	5.79	7.10	1179	18.46	3490	18.47	2.58	0.446
T₅- 24 hour	6.25	7.41	1287	19.26	3586	19.26	2.24	0.339
T₆- 28 hour	5.68	6.87	1142	18.02	3329	17.88	2.49	0.487
T₇- 32 hour	5.37	6.52	1037	16.54	3111	17.02	2.84	0.597
MEAN	5.54	6.78	1115	17.54	3245	17.54	2.72	0.544
S.Em±	0.06	0.05	12.64	0.09	50.80	0.17	0.04	0.007
CD @ 1%	0.17	0.16	37.43	0.25	150.42	0.51	0.12	0.020

Fig.1a & 1b Effect of hydropriming durations on germination (top) and speed of germination (bottom) of spinach



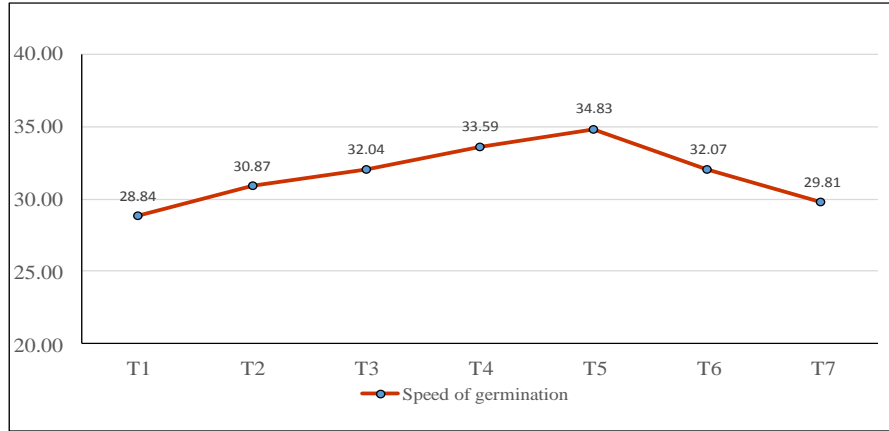
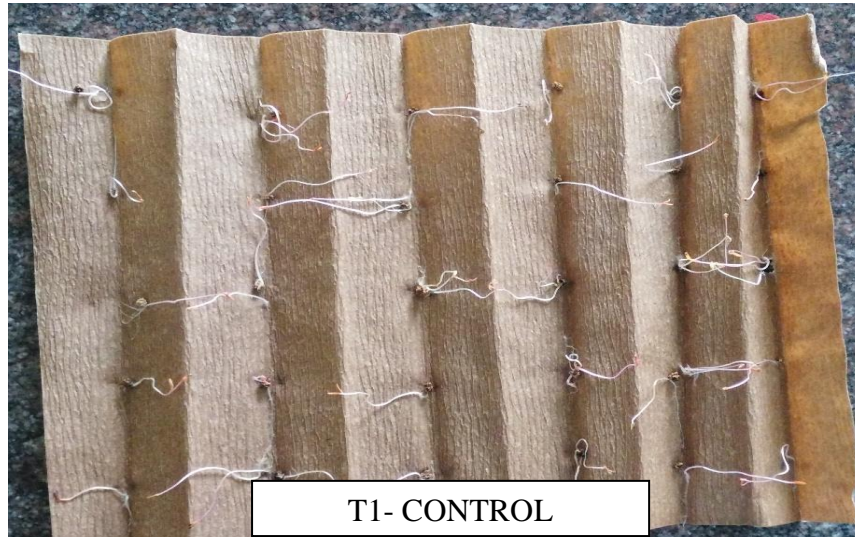


Fig.2a & 2b Effect of standardization of hydropriming durations on germination (%) of spinach



The possible reason for enhanced seed germination and vigour at 24 hours of seed hydro-priming might be due to completion of pre-germinative metabolic processes *i.e.*, activation and synthesis of a number of enzymes and nucleic acids repair and build up, ATP synthesis and the cytoplasmic membrane repair in hydro-primed seed a head start over the non-primed seeds making ready for radical protrusion (Varier *et al.*, 2010) and also during priming, several processes including treated seeds start to develop (Fig 2b). These results are in conformity with Krishnakumar *et al.*, (2008) in sugar beet, Tiwari *et al.*, (2014) in amaranthus, Mohsen *et al.*, (2013), Kamithi *et al.*, (2016), Kaur *et al.*, (2003), Kazem *et al.*, (2012), Abebe (2014) and Rashid *et al.* (2004) in spinach.

Soaking of spinach seed at both the intervals *i.e.*, below (<24 h) and above (>24 h) 24 hours resulted in reduced seed quality parameters (Habib, 2010). The germination of spinach seeds is inhibited by water treatments when soaked for more than 24 hours (28 and 32 h) due to membrane disintegrate of seed coat and increased movement of seed leachates resulting in low germination and vigour and also because of higher porosity where water filled pores restricted oxygen access to the fruits. Heydecker *et al.*, (1971) in beetroot reported that the germination was negatively affected by excess water treatment. The seed quality parameters reduced when soaked for less than 24 hours (12, 16 and 20 h) which might be due to incomplete imbibition resulting in reduced activity of hydraulic enzymes required for reserve mobilization of storage food (Perry and Harrison, 1974). Similar results were given by Orzeszko-Rywka and Podlaski (2003) in palak and Heydecker (1967) in *Beta vulgaris*.

The seeds were subjected to hydro-priming durations from 0 to 32 hours. These seeds were tested for seed quality parameters to

standardize the hydro-priming duration. Among the different hydro-priming durations studied, the seed hydro-primed for 24 hours (T5) duration recorded significantly highest seed quality parameters *viz.*, seed germination (94.25%), speed of germination (34.83), root length (6.25cm), shoot length (7.41 cm), seedling dry weight (19.26 mg), seedling vigour index (1287), germination rate index (3586), peak value of germination (19.26), mean germination time (2.24) and lowest electrical conductivity (0.339 dsm-1) and was on par with the soaking duration for 20 hours (T4) which recorded 91.50 %, 33.59, 5.79 cm, 7.10 cm, 18.46 mg, 1179, 3490, 18.47, 2.58 and 0.446 dSm-1, respectively. However, significantly minimum seed quality parameters were observed in control (without soaking) (*i.e.* 86.00%, 28.84, 5.16 cm, 6.25 cm, 16.03 mg, 981, 2908, 15.59, and 3.19, respectively). However electrical conductivity was significantly highest in control (0.733 dSm⁻¹). In conclusion seeds hydroprimed for 24 hours were found to be ideal for obtaining better seed quality parameters.

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