

Effect of Thermopriming on Germination in Rapeseed (*Brassica napus* L.)

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ABSTRACT

In many crops pre-soaking or priming causes improvement in germination and seedling establishment. Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops, particularly seeds of vegetables and small seeded grasses. In order to determine the impact of thermopriming on germination of basil seeds, an experiment was conducted at Islamic Azad University, Shahr-e-Qods Branch, Tehran, Iran in 2011 by a completely randomized design with three replications, seed viability was determined by Tetrazolium test method. The factors studied included different time thermopriming (non-primed, 10 and 20 minutes) through the placing seeds were exposed to oven. The results showed that the effect of thermopriming was non-significant on germination percentage, seedling dry weight, seedling vigour and seedling length. Mean comparison showed that the highest germination percentage (99 %) came up to 20 minutes thermopriming and highest seedling dry weight (0.03 gr), seedling vigour (2.86) and seedling length (3.33) were achieved by non-primed. Therefore, use of thermopriming shouldn't be in seeds of rapeseed under laboratory condition.

Key words: Thermopriming, seedling vigour, germination and rapeseed.

Introduction

Rapeseed is one of the important oil-producing crops worldwide. Its oil is rich in non saturated fatty acids, tocopherols and phytosterols. Phytosterols are composed of 17 carbon atoms with a characteristic three-dimensional arrangement of four rings. They play a great role in human nutrition and lower LDL cholesterol [15,27,35]. The mean soil temperature in the rapeseed production area of western Canada ranges from 5 to 13°C at a 5-cm depth. The optimal temperature for rapeseed germination and emergence is 15 to 20°C [18]. Seed germination and seedling emergence result from a sequence of biological events initiated by water imbibition followed by enzymatic metabolism of storage nutrients. All of those events are regulated by the environment and

the quality of the seed [18]. Both suboptimal soil temperature and lack of soil moisture delay and reduce germination percentage and seedling emergence [18,19,6]. Seed priming is a pre-germination seed treatment in which seeds are held at water potential that allows imbibition, but prevents radicle extension [4]. Seed priming has been used to improve germination, reduce seedling germination time, improve stand establishment and yield [17]. In priming enhancement of physiological and biochemical events in seeds takes place during suspension of germination by low osmotic potential and negligible matric potential of the imbibing medium. Salts or non-penetrating organic solutes in liquid medium (osmoconditioning) or solid matrices (matricconditioning) are used to establish an equilibrium of water potential between seed and

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osmotic medium needed for conditioning [17]. Priming also expands the temperature range at which germination may occur [36]. Seed priming is a technique in which seeds are partially hydrated until the germination process begins, but radicle emergence does not occur [4]. Priming allows the metabolic processes necessary for germination to occur without actual germination. Primed seeds usually exhibit an increased germination rate, greater germination uniformity, and, at times, greater total germination percentage [5]. Increased germination rate and uniformity have been attributed to metabolic repair during imbibition [7], buildup of germination enhancing metabolites [5], osmotic adjustment [4], and, for seeds that are not redried after treatment, a simple reduction in imbibition lag time [4]. Other scientists have given excellent reviews on seed priming. The beneficial effects of priming have also been demonstrated for many field crops such as wheat, sugar beet, maize, soybean and sunflower [28,32,30]. Likewise, Harris *et al.*, [11] reported that the direct benefits of seed priming in all crops included faster emergence, better, more and uniform stands, less need to re-sow, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield. Under field conditions poor seed quality not only reduces the final crop stand but also delays the onset of germination and adversely affects the seedling vigour. Seed quality is considered as a major tool of a variety development in seed production and breeding process. Seed quality should be taken as a complex of biological value and other seed parameters. In the practice the expression seed quality is used loosely to reflect the overall value of seed for its intended purpose, the performance of seed must measure up to the expectations of the end user of that seed [13]. Stability of seed quality is influenced by environmental conditions and by genotype environment interaction similarly as stability of yield. Stability of evaluated seed characteristics is possible to assess by various statistical methods, used for example by Ackura *et al.* [1] for parametric stability analyses of durum wheat (*T. durum* Desf.).

Materials and methods

In order to determine the effect of thermopriming on germination in rapeseed seeds, an experiment was conducted in 2011 at Laboratory Sciences, Islamic Azad University Shahr-e-Qods Branch by a completely randomized design with three replications and the first, seed viability was determined by Tetrazolium test method. The factors studied included different time thermopriming (Non-primed, 10 and 20 minutes) through the placing seeds were exposed to oven. After disinfecting, seeds were put in disinfected Petri dish. Each Petri dish contained 100 seeds.

Three replicates of 100 seeds were put between double layered rolled. The rolled paper with seeds was put into sealed plastic bags to avoid moisture loss. All of the Petri dish irrigated by distilled water. Seeds were allowed to germinate at $25 \pm 1^{\circ}\text{C}$ for 8 days. Germination percentage was recorded after the 8th day. Germination percentage was calculated with the following formula:

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Number of total seeds}} \times 100$$

Also, Seedling vigor index was calculated by the following formula:

$$\text{Seedling vigor index} = \frac{\text{Germination percentage} \times \text{Seedling dry weight}}{\text{Seedling dry weight}}$$

Statistical Analysis:

Data analyses were performed using the Spss statistical software (Version 16). Mean separations were performed by Duncan's multiple range test (DMRT) at 5% level.

Results and discussion

The results showed that the effect of thermopriming was non-significant on germination. The germination percentage increased by increasing in thermopriming time and highest germination percentage were achieved by 20 minutes thermopriming (Table1, Fig1). But the highest seedling dry weight, seedling vigour and seedling length were achieved by non-primed treatment (Table1, Fig 2, 3 and 4). Lower germination and vigor in the seeds from the crop cultivated during summer is ascribed to the high atmospheric temperatures during pod drying [22,26] and high relative humidity during subsequent storage [23,25,24]. Physiological maturity of seed at harvest is usually defined as the time when seed attains its maximum dry weight (ISTA 1987). However, reports are available on differences in seed size, and germination and seedling vigour in groundnut [31,33]. Fast germination is due to the synthesis of DNA, RNA and protein during priming [7]. The increased plant biomass might be due to synchronized germination and early stand establishment in treated seeds [17]. Pill and Necker [29] who reported that matriprimed compared to non-primed resulted in greater shoot dry weights in Kentucky blue grass. The probable reason for early emergence of the primed seed may be due to the completion of pre-germinative metabolic activities making the seed ready for radicle protrusion and the primed seed germinated soon after planting compared with untreated dry seed [14]. These findings agree

Table 1: Means Comparison

Seedling length (cm)	Seedling vigour	Seedling dry weight(gr)	Germination percentage	Thermopriming (Minutes)
3.33a	2.86a	0.03a	95.66a	0
3.50a	1.89a	0.02a	94.66a	10
1.50a	1.98a	0.02a	99a	20

Means within the same column and factors, followed by the same letter are not significantly difference.

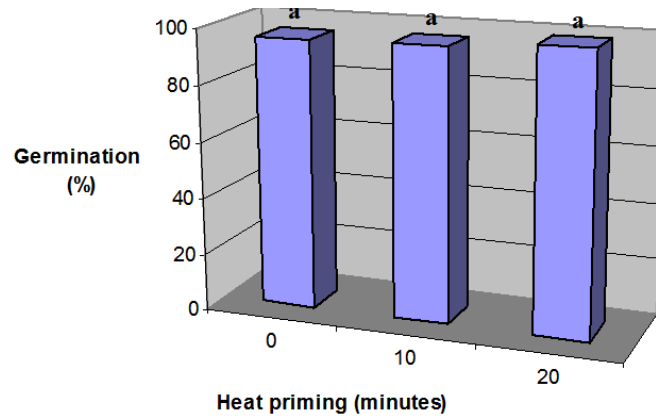


Fig. 1: Effect of thermopriming on germination percentage in rapeseed.

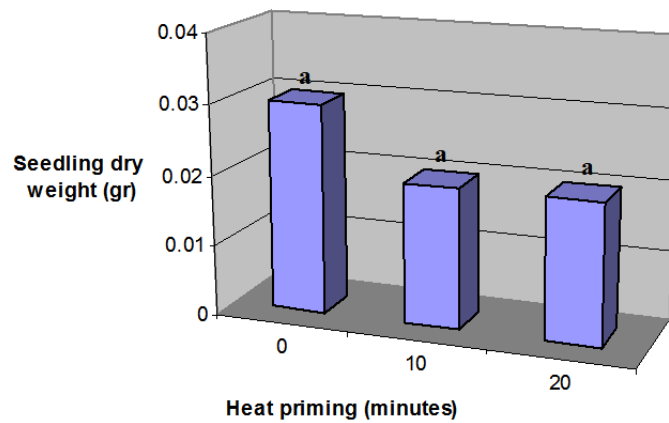


Fig. 2: Effect of thermopriming on seedling dry weigh in rapeseed.

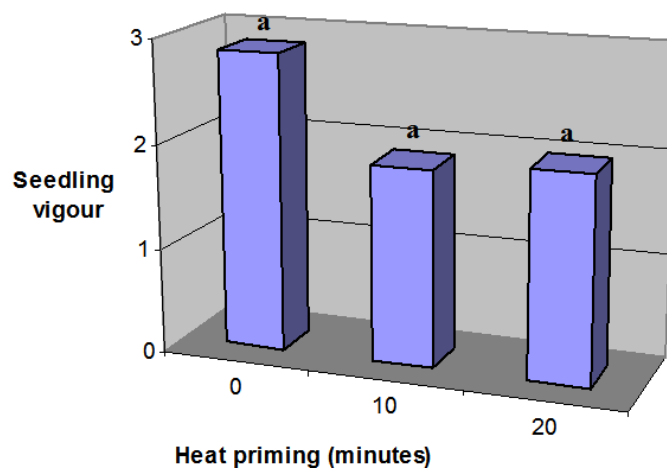


Fig. 3: Effect of thermopriming on seedling vigour in rapeseed.

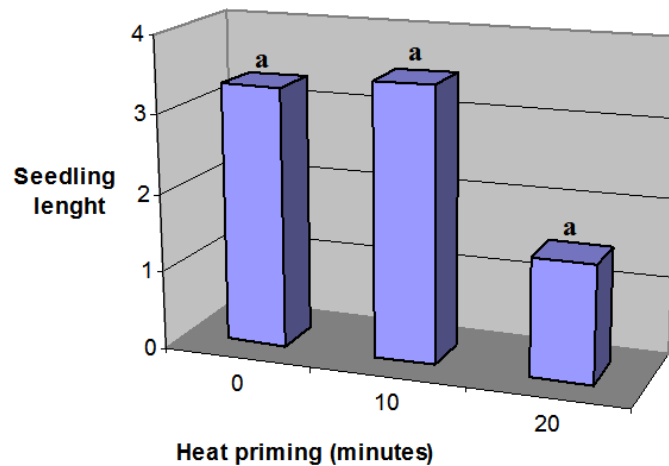


Fig. 4: Effect of thermoprimering on seedling length in rapeseed.

with Brocklehurst *et al.* [8] who reported faster emergence of primed seed. In agreement with these findings, several other reports showed improved and early seedling emergence in sorghum, millet, cotton, beans and maize as a result of water priming [9,10,20]. The observed improvements in emergence of primed seed may be attributed to priming that induces quantitative changes in biochemical content of the seed and improves membrane integrity and enhances physiological activities at seed germination [34]. The improvement in emergence of primed seed may be due to the fact that priming induces a range of biochemical changes in the seed that are required to initiate the germination process, breaking of dormancy, hydrolysis or metabolism of inhibitors, imbibition and enzymes activation [2]. Likewise Asgedom and Becker [3] reported that some or all processes that precede the germination are triggered by priming and persist following the re-desiccation of the seed. The improved yield of primed seed plots may be due to early and improved emergence in the priming treatments that ultimately resulted in the higher yield. The resulting improved stand establishment due to priming can reportedly increase drought tolerance, reduce pest damage and increase crop yield [10,21,12]. The increase in yield of primed seed plots may be due to the fact that primed seed emerge faster and more uniformly and seedlings grow more vigorously, leading to a wide range of phenological and yield related benefits [12]. Harris *et al.*, [10] further reported that primed crops produced higher yields than non primed crops.

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