The Role of Thermo Priming on Improving Seedling Production Technology (Ispt) in Soybean [*Glycine max* (L.) Merrill] Seeds

Behzad Sani, Vida Jodaeian

Abstract**—**In order to determine the impact of thermo priming on germination of soybean seeds, an experiment was conducted as a completely randomized design with three replications. The factors of studied included different time thermo priming (control, 5 and 10 minutes) through the placing seeds were exposed to oven. The results showed that the effect of thermo priming was significant on germination percentage, seedling dry weight and seedling vigour in P ≤ 0.05. Mean comparison showed that the highest germination percentage (77%), seedling dry weight (1.39 g) and seedling vigour (107.03) were achieved by 10 minutes thermo priming.

Keywords**—**Thermo priming, seedling, seedling production, seedling growth, soybean.

I. Introduction

SOYBEANS originated in Asia and were first introduced to Europe and North America as a forage crop [1]. It is now only used as a forage crop if there is a need for extra forage, or if the soybean crop had been damaged too severely for use as a grain crop.

Reference [2] found that some of the recently developed cultivars were able to produce up to 12 t ha^{-1} DM in southern England, although the average was 9.2 t ha^{-1} DM across the eight cultivars tested. Initial growth of forage soybeans appears to be determinate in nature forming a bush habit, but some cultivars will have an indeterminate habit as the photoperiod shortens.

Lodging can occur with increasing maturity, particularly under wet conditions.Since the soybean is a subtropical plant it generally grows best between 25$^{℃}$ and 30$^{℃}$. To prevent the buildup of soil-borne diseases, soybeans should not be grown on the same site for more than two years.

They should not follow edible beans, canola (oilseed rape), or sunflowers, because diseases like white mould (*Sclerotinia sclerotium*) can carry over and reduce soybean yields.

In temperate areas, the crop should be sown once soil temperatures have reached 10$^{℃}$, and grown until the plant reaches a maximum growth stage R7. This may take up four months depending on climate, photoperiod and the cultivar sown. If the climate allows it may is possible to grow the crop as a short-term catch crop after harvesting a winter-sown cereal in mid-summer.

Moderately fertile soils are particularly suitable. Soil pH 6.0 and above are required. Rhizobial relationships Rhizobial inoculation of seed with *Bradyrhizobium japonicum* is beneficial to nodulation, plant growth and nitrogen fixation on soils where soybeans have not been previously grown. Soil applied granular inoculants, up to 10 kg ha^{-1}, can provide more consistent nodulation and higher yields than seed applied inoculum [3].

If sown at soil temperatures below 10ºC, it may be necessary to apply fertilizer N to the field to insure good crop growth until the *Rhizobium*-plant relationship is initiated. Soybeans require root zone temperatures between 25ºC and 30$^{℃}$ for optimal establishment of symbiotic activity.

Well prepared firm seedbed with good surface farm, allows rapid even germination without risk of crusting. Ideal sowing depth for soybeans is between 2.5 and 4 cm; shallow sowing is recommended for cool soils.

Deeper sowing exposes the seedling to greater risk of damage from soil-borne pathogens and poor emergence of those cultivars with short hypocotyls. Increased shoot and root length may be due to early emergence induced by priming treatment as compared to un-primed seeds.

Reference [4] presented the same results by observing that priming of the pepper seeds significantly improved root length.

Stress tolerance due to pre-treatment of seeds suggests that these molecules trigger the expression of the potential to tolerate stress rather than having any direct effect as a protectant [5].

It is well established that a vigourous seed can produce a better seedling under stress conditions than the non-vigourous one.

All the priming treatments showed improved germination as compared to non-primed seeds which was due to increased shoot and root length of seedlings from primed seeds and so much more vigourous than [6] also suggested that priming treatments improves the vigour of the seeds.

Primed seeds usually exhibit the increased germination rate, reduced mean germination time, greater germination uniformity and sometime greater total germination percentage in many plant species [7], [8].

These were consistent with the [9] findings on rice seedling establishment in flooded soil and [10] view that high vigour seed lot would perform better in field performance under

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environmentally stressed seed bed conditions than low-vigour seed lots. Primed seeds might have better plasma membrane structure by slow hydration [7].

Priming also causes to reduce the adherence of seed coat due to imbibition, which may permit to emerge out redicle without resistance as [11] reported that the priming minimizes seed coat adherence during emergence of muskmelon seeds.

Rapid embryo growth resulted when the obstacle to germination was removed [12]. These changes include macromolecular synthesis, several enzyme activities, increase in germinating power and vigour and overcoming of dormancy [12], [13].

II. Material and Methods

In order to determine the impact of thermo priming on germination of soybean seeds, an experiment was conducted as a completely randomized design with three replications. The factors studied included different time thermo priming (control, 5 and 10 minutes) through the placing seeds was 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 ± 3 $^{\circ C}$ for 9 days. Germination percentage was recorded after the 9th day.

Germination percentage was calculated with:

Germination percentage = Number of germinated seeds / Number of total seeds × 100

Also, Seedling vigour index was calculated by:

Seedling vigour index = Germination percentage × Seedling dry weight

Data were subjected to analysis of variance (Spss) computer software at $P < 0.05$.

III. Results and Discussion

A. Germination Percentage

The results showed that the effect of thermo priming was significant on germination percentage in $P \leq 0.05$.

The highest germination percentage (77 %) was achieved by 10 minutes thermo priming and lowest germination percentage (60 %) was achieved by control treatment (Table I, Fig. 1).

B. Seedling Dry Weight

The results showed that the effect of thermo priming was significant on seedling dry weight in $P \leq 0.05$.

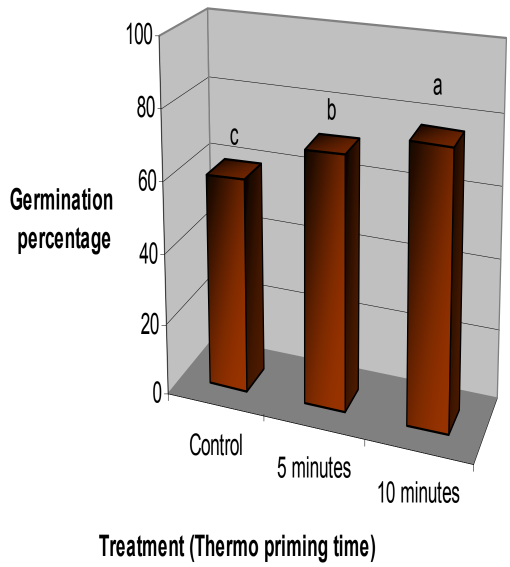

Fig. 1 Effect of thermo priming on germination percentage in soybean

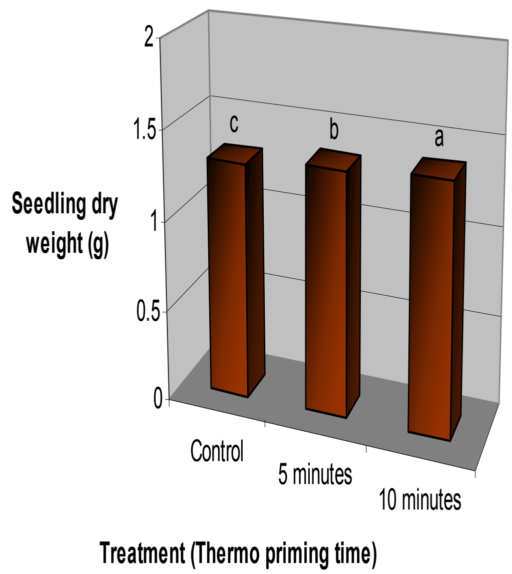

Fig. 2 Effect of thermo priming on seedling dry weight in soybean

The highest seedling dry weight (1.39 g) was achieved by 10 minutes thermo priming and lowest seedling dry weight (1.31 g) was achieved by control treatment (Table I, Fig. 2).

C. Seedling Vigour

The results showed that the effect of thermo priming was significant on seedling vigour in $P \leq 0.05$.

The highest seedling vigour (107.03) was achieved by 10 minutes thermo priming and lowest seedling vigour (78.60) was achieved by control treatment (Table I, Fig. 3).

In general, mature seeds tend to show better germination than those of earlier and later harvests, while advancement obtained by priming is greater in earlier harvests (premature seeds). Priming is also a valuable process for improving germination and uniformity of heterogeneously matured seed lots [14].

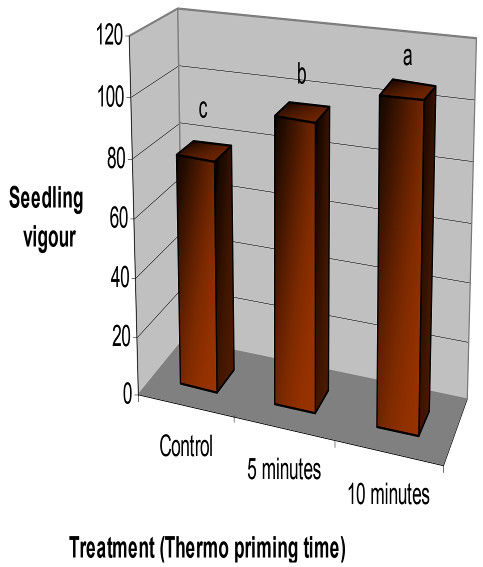

Fig. 3Effect of thermo priming on seedling vigour in soybean

TABLE I
MEANS COMPARISON

Treatment (Thermo priming time)	Germination percentage	Seedling dry weight (g)	Seedling vigour
control	60 [c]	1.31 [c]	78.60 [c]
5 minutes	71 [b]	1.35[b]	95.85 [b]
10 minutes	77 [a]	1.39 [a]	107.03 [a]

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

Seed priming is a pre-sowing seed treatment that improves seed performance by increasing germination rate and uniformity. Priming exposes seeds to imbibition in low external water potentials that allows seed partial hydration [15].

Seed priming may also increase the seed or seedling tolerance to stress. Priming initiates metabolic activities, such as protein, RNA, and DNA synthesis, DNA replication, and b-tubulin accumulation [16].

Recently, it has been suggested that priming could enhance the activity of antioxidative systems, resulting in lower rate of lipid peroxidation, contributing to seed invigoration [17].

Seed priming enhances seed performance by rapid and uniform germination, normal and vigourous seedlings, which resulted in faster and better germination in different crops [18].

It permits seedling development in a wide range of agro-climatic conditions and decreases sensitivity to external factors [19].

Seeds performance of various crops can be improved by inclusion of plant growth regulators and hormones during priming and other pre-sowing treatments [20].

Priming is responsible to repair the age related cellular and sub cellular damage of low vigour seeds that may accumulate during seed development [21].

Priming improves the seedling growth [22]. Primed seeds had better efficiency for water absorption from growing media and it is obvious that metabolic activities in seed during germination process commence much earlier than radicle and plumule appearance, that is, emergence [23].

These results are in accordance with the results of other researchers. References [24], [25] reported that priming the bitter gourd seeds before sowing overcame sub-optimal environmental effects on germination subsequent seedling establishment performance. Reference [26] reported that, both thermo and hydro priming seeds showed significant increase in germination performance. The resultant effect of priming depends on the used method and time of treatment.

Hydropriming is a simple method of priming treatment. It does not require any special technical equipment and owing to the use of distilled water as a priming medium. It is probably the cheapest priming method.

Similarly [27] presented hydropriming as a simple and inexpensive method of seed priming.

Priming may improve germination by accelerating imbibition, which in turn would facilitate the emergence phase and the multiplication of radicle cells [28].

The technique of seed priming is becoming familiar to farmers in several parts of the world, and has now been promoted there on a range of crops, for example wheat [29] and mung bean [30], where similar responses to those reported here have been found. In many coated seeds, germination and subsequent seedling growth can be inhibited by mechanical restriction exerted by the seed coat [31].

Priming may be helpful in reducing the risk of poor stand establishment under drought and salt stress and permit more uniform growth under conditions of irregular rainfall and drought on saline soils.

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