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EFFECT OF PRE-TREATMENT AND SOWING DEPTH TOWARDS GERMINATION OF *Coriandrum sativum* AND *Lathyrus odoratus* SEEDS

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Abstract

Seed germination has recently reinvigorated interest, owing to its importance in the natural development of plants and the cultivation of crops. However, germination of seeds, especially *Coriandrum sativum* and *Lathyrus odoratus,* can sometimes be difficult or impossible due to multiple factors, such as the condition of the seeds themself. The purpose of this study is to examine the effect of pre-treatment on the germination of *Coriandrum sativum* and *Lathyrus odoratus* seeds. The experiment was set up in a completely randomized design involving three replicates. The treatments were soaked in tap water for 48 hours (Type A), in tap water for 24 hours (Type B), 6% H_2O_2 (Type C), abrasion with sandpaper (Type D), scarification with mortar and pestle (Type E), and control (no pre-treatment) (Type F). The most suitable depth level for seed germination and seedling growth of *Coriandrum sativum* and *Lathyrus odoratus* were also investigated. The results show that germination of *Coriandrum sativum* was highest (93.3±6.67) when immersed in 6% hydrogen peroxide (H_2O_2), while the germination percentage of *Lathyrus odoratus* was highest (46.7±17.64) when immersed in tap water for 48 hours. Furthermore, *Coriandrum sativum* seedlings germinated efficiently at a depth of 2.0 cm, while seedlings of *Lathyrus odoratus* have the highest germination percentage at 0.0 cm (control). Hence, this study can provide useful information about the influence of pre-treatment and sowing depth on the germination of these two plant species, which can directly improve the germination process.

Keywords: sowing, germination, scarification, *Coriandrum sativum*, *Lathyrus odoratus*.

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Introduction

Recently, there has been renewed interest in seed germination due to the necessity for the normal development of plants, growing crops, and the production of food for humans. Germination can also be complex or impractical due to a variety of variables, as seeds have varying requirements. Note that incapable of germinating means no living. Having the best possible setting for seedlings to get off to a good start is critical. Temperature, humidity, soil content, and depth are all critical variables to monitor. Some plants, such as coriander (*C. sativum*) seeds, tend to dry easily, while sweet pea (*L. odoratus*) develop a hard seed coat that makes it difficult for the seed to germinate. Coriander has therapeutic properties, and fresh leaves and dried seeds are used in culinary spices due to its aromatic flavor. Sweet pea is a popular flowering crop grown for its intense, unique fragrance. Malaysia was the largest importer of coriander (*C. sativum*) from India in 2014-2015, but due to a crop failure in 2015-2016, coriander exports from India slowed (Kale et al., 2017). Sweet pea (*P. sativum*) production, on the other hand, has some unique challenges because its seeds are extremely difficult to germinate for a variety of reasons. This varies depending on genotypes, agronomic variables, and local climate conditions but could be improved by implementing some innovative techniques (Chouhan, 2018). Some evidence also suggests that seeds need pre-treatment to encourage sprouting, although further work using the pre-treatment method is required to confirm this finding (Tian et al., 2014).

It is important to understand the essence of seed germination in plant growth. This is a comparative study on pre-treated seed germination and sowing depths towards the germination of *C. sativum* and *P. sativum* seeds. This study aims to enhance the germination percentage of the species. This is because the most sensitive and essential phases in the development cycle of plant species are seed germination and seedling establishment, which ensures plant survival (Jamshidian and Talat, 2017). This study determined the germination percentage of seeds using pre-treatment, which is soaked in tap water for 48 hours, soaked in tap water for 24 hours, scarify using 6% hydrogen peroxide (H_2O_2), scarify using sandpaper, as well as scarify using mortar and pestle. Besides, to determine and compare suitable depth levels for seed germination and to determine the growth performance of *C. sativum* and *P. sativum* seedlings within two weeks. The production of both plant species will also increase directly if the germination process is improved (Muttaqin et al., 2019).

Methods

The species studied were *C. sativum* and *L. odoratus,* with different seed coat thicknesses. Experiments were conducted in three steps for each of the species. First, start with seed pre-treatment before germination to determine the germination percentage. The second is sowing the seed at different depths to determine the photoblastic requirement. The final step is to determine the shoot and root length in determining the growth performance according to the treatments given.

Pre-treatment procedure:

The surface of the seed samples was sterilized with 70% isopropyl alcohol to eliminate diseases caused by organisms. Then, each sampled seed of both types was divided into six sets having five individual seeds for each different treatment, soaked in tap water for 48 hours (Type A), soaked in tap water for 24 hours (Type B), acid scarification using 6% H_2O_2 (Type C), scarification using sandpaper (Type D) and using a mortar and pestle (Type E). Each of the steps was repeated three times for replication and sown before being watered with 50 mL of water once daily for 14 days. The germination percentages, shoot length, root length and stem diameter were measured after 14 days to determine the best pre-treatment method.

Sowing depth procedure:

Both types of seeds were treated with the best pre-treatment based on procedure 1. The pH and the moisture of the soil at each depth were measured using soil hygrometers. Five individual seed samples in each treatment of both plant species were sown at the depths of 2.0 cm, 6.0 cm, and 10.0 cm. Seeds that were sown at 0.0 cm were used as a control. The procedure was repeated three times for replication. Then, the sown seeds sample were placed under direct sunlight and minimal shades in random placement. Each sample was also watered with 50 mL of water once daily. The seedling emergence in each of the samples was observed, and the germination percentage, shoot lengths, root lengths as well as stem diameter were recorded after 14 days (2 weeks).

Data analysis:

The gathered data were evaluated using one-way analysis of variance (ANOVA) with the Post Hoc Test, which will assist in the determination of specific results in this study. The Software SPSS version builds 1.0.0.1406 was used to determine the significant differences between the dependent variable's means of germination percentages, shoot lengths, root lengths, and stem diameter. The germination percentages (GP) were calculated using the formula below. The number of seeds germinated (SG) was divided by the number of seeds sown (TS): $GP = SG/TS \times 100$.

Result and Discussion

Pre-treatment improved germination percentage in *C. sativum* plants more than untreated seeds. Table 1 shows that the seeds of *C. sativum* that were pre-treated with 6% H_2O_2 for 20 minutes (Type A) had the highest germination percentage (93.3±6.67%) while the lowest germination percentage was Type D (66.7±6.67%) using mechanical scarification (sandpaper).

The application of H_2O_2 has wrecked the covers and improved the germination. It was discovered that H_2O_2 acts as a priming factor for seed germination, causing particular changes at the proteome, transcriptome, and hormone levels, resulting in an increase in the germination process due to invigoration of the seeds (Espin et al., 2012).

On the other hand, the seeds of *L. odoratus* that were imbibed with tap water for 48 hours (Type A) had the highest germination percentage (46.7±17.64%), similar to the control (46.7±6.67), followed by soaking in tap water for 24 hours (40.0±11.55%). In contrast, Type E, which used mechanical scarification (mortar and pestle), had the lowest germination percentage (6.67±6.67%). According to Muhammad et al. (2020), even though de-coated seeds using scarification manually grew faster than other treatments, their germination percentage is lower. The initiation of germination needs the presence of water and oxygen. Imbibition of water has mobilized the carbohydrate in endosperm once the hormone gibberellin stimulates *de novo* synthesis of α-amylase by the aleurone layer (Hopkins and Huner, 2009). Therefore, pre-treatment that allows instant water intake throughout the seeds may perform a higher germination percentage.

Table 1. Germination percentage of *C. sativum* and *L. odoratus* seeds in the different pre-treatments method.

Treatment	**Pre-treatment**	**Germination Percentage (%)**	
		C. sativum	***L. odoratus***
A	Soaked in tap water (48 hours)	73.3±6.67	46.7±17.64
B	Soaked in tap water (24 hours)	86.7±6.67	40.0±11.55
C	Acid scarification (6% H_2O_2)	93.3±6.67*	33.3±13.33
D	Mechanical scarification (Sandpaper)	66.7±6.67	20.0±11.55
E	Mechanical scarification (Mortar and pestle)	73.3±6.67	6.67±6.67*
F	No pre-treatment (Control)	86.7±6.67	46.7±6.67

The germination percentage values are indicated as mean ± standard error (SE) values. a) * The mean different is significant ($P < 0.05$).

The seeds of *C. sativum* pre-treated with acid scarification (H_2O_2) for 20 minutes (Type C) have been the most effective in growth performance, with the mean shoot length was 11.52±0.27 cm and root lengths of 4.37±1.20 cm. Meanwhile, scarifying seeds with a mortar and pestle was the least effective method, and the significant mean value for root length was 2.38±0.35 cm and a mean value of 10.9±0.50 cm for shoot length (Figure 1(a) & (b)). *L. odoratus* soaked in tap water for 24 hours (Type B) has the highest mean values for shoot length of 22.89±2.98 cm, whereas scarifying seeds with a mortar and pestle was the least effective at 4.93±4.31 cm. Meanwhile, the mean value for root length of Type B was 7.85±1.36 cm and 2.97±2.31 cm for Type E. The *L. odoratus* has a bigger seed size; therefore, the overall growth was much higher than *C. sativum.*

The *L. odoratus* seedlings also show different growth performances for each type of treatment given. The most notable growth performance of *L. odoratus* was those pre-treated with solutions compared to the physical pre-treatment. Meanwhile, *C. sativum* performed the best in the pre-treatment of H_2O_2 even though there was no significant difference among the treatments. According to Omokhua *et al*. (2015), early germination produced by the chemical resulted in strong seedlings than seedlings from untreated seeds, which could explain the large improvement in emerging seedling growth. They also stated that plant seedlings exposed to hydrogen peroxide (H_2O_2) might grow faster due to increased oxygen and water intake.

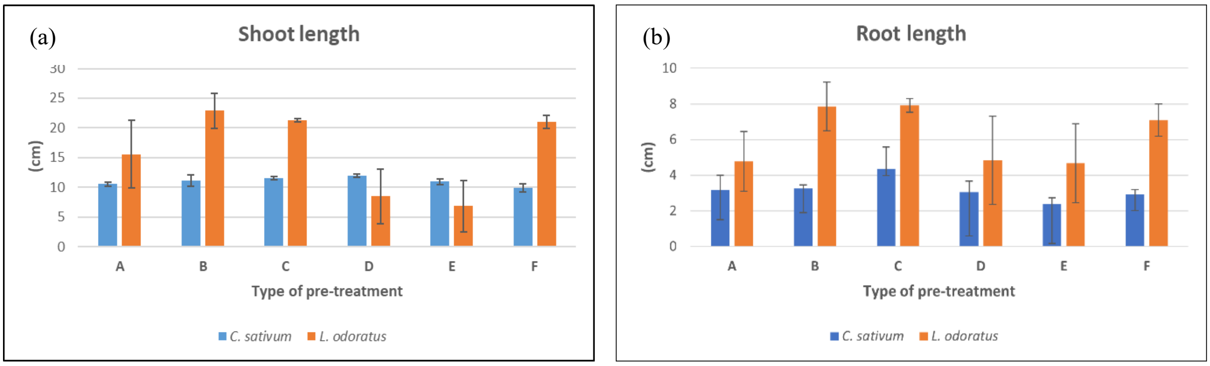

Figure 1. Bar graph of (a) shoot length and (b) root length of both species for pre-treatment method.

There was a significant difference between the means for germination percentages and growth parameters in different sowing depths (P<0.05). Based on Table 2, *C. sativum* seeds germinate better at 2.0 cm (60.0±0.00) than at 10.0 cm (20.0±11.55), while *L. odoratus* seeds germinate greater at 0.0 cm (T4) which 53.33 ± 6.67% followed by T1 (13.33 ± 6.67%) and T2 (13.33 ± 13.33%) than T3 (6.67 ± 6.67%).

Table 2. Germination percentage of *C. sativum* and *L. odoratus* seeds in different sowing depths.

Treatment	**Depth (cm)**	**Germination Percentage (%)**	
		C. sativum	***L. odoratus***
T1	2.0	60.0±0.00	13.33±6.67
T2	6.0	33.33±6.67*	13.33±13.33
T3	10.0	20.0±11.55	6.67±6.67
T4	0.0	33.33±13.33	53.33±6.67*

The germination percentage values are indicated as mean ± standard error (SE) values. *The mean difference is significant (P< 0.05).

The mean root length of the species sown at 0.0 cm and 2.0 cm was significantly different compared to others (P<0.05). Hence, the shallower the soil, the longer the root length. This is due to hydrotropism (Dietrich, 2018) when the content of moisture was less (50 – 70%) (Table 3). *C. sativum* is a plant that is moderately sensitive to water stress, causing the height of *C. sativum* plants to decrease due to this factor (Unlukara et al., 2016). This study has proven that *C. sativum* seeds that are sown at 10.0 cm have the lowest mean root length of 2.20±0.17 cm but have a shoot length of 7.45±1.28 cm (Figure 2 (a) & (b)). The high moisture (80%) at a depth of 10 cm has shown that the roots do not need to lengthen due to the water source being within the root zone. When compared to *L. odoratus*, the results show that the mean root length of the species sown at 0.0 cm and 2.0 cm was significantly different compared to others (P<0.05). Hence, the shallower the soil, the longer the root length. The root length sown at 0.0 cm as a control had the greatest significant mean values but a shoot length of 6.22±0.99 cm [Figure 2 (a)].

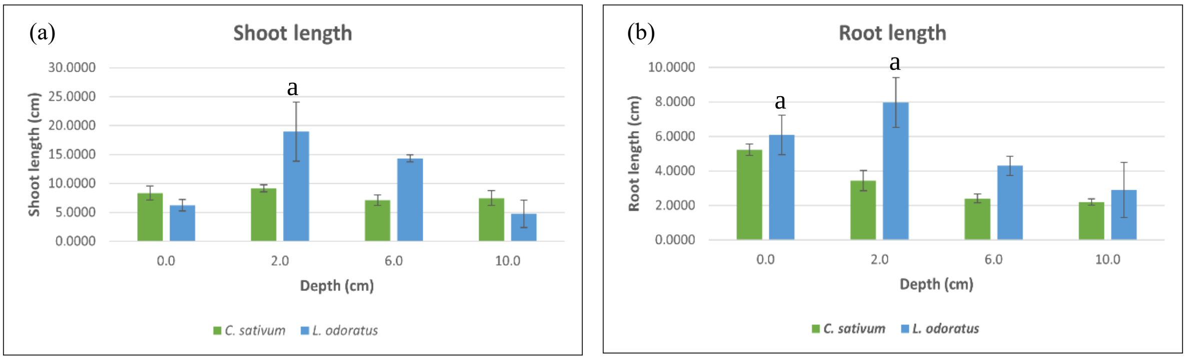

Figure 2. Bar graph of (a) shoot length and (b) root length after 2 weeks growth between both species in different depth. [a] The mean different is significant ($P < 0.05$).

Table 3. Soil conditions at different depths.

Depth (cm)	**pH**	**Moisture (%)**
0.0	6.5	50
2.0	7.0	70
6.0	7.0	70
10.0	7.5	80

The growth zone more than 3 mm from the root apex is particularly vulnerable to the inhibitory effects of low soil water content, according to the kinematic analysis of root elongation in the research. At low soil water content, the phytohormone ABA is also a key regulator of root growth, both directly and through interactions with ethylene (Lynch et al., 2012).

Conclusion

The finding of this study revealed that soaking *C. sativum* in 6% hydrogen peroxide (H_2O_2) results in the highest germination percentages. In contrast, imbibition in tap water for 48 hours results in the highest germination percentages for *L. odoratus.* Furthermore, *C. sativum* and *L. odoratus* had the best shoot growth and seedling emergence at a depth of 2.0 cm. *L. odoratus* extend the roots longest from the level of 2.0 cm; meanwhile, *C. sativum* had the longest root growth sown at 0.0 cm. This finding confirms that as sowing depths deeper, germination percentages and growth of both species reduced significantly. Future research suggests using a standard double pre-treatment approach to improve germination percentage and early growth development of both species to enhance seed viability. Finally, different types of soil should be employed to investigate the effects of different soil conditions and textures on the germination of *C. sativum* and *L. odoratus* seeds to gain a better understanding of the issue.

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Author Contribution

MIM Awang Hin – conceptualization, data curation and writing; N Abu Shah – supervision, review and editing.

Conflict of Interest

Author declares no conflict of interest.

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