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Percentage Germination and Seedling Evaluation Parameters of Parsley (*Petroselinum crispum*) Seeds as Affected by Different Priming Treatments and Durations

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Authors' contributions

This work was carried out in collaboration with both the authors. Author KSK designed the study, performed statistical analysis and wrote the first draft. Author FNWM managed the analysis of study. She also ensured the design, implementation of the study, analysis and discussions were done as per scientific principles. Both the authors read and approved the final manuscript.

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ABSTRACT

Aim: To investigate the effect of different priming pretreatments and durations on germination of parsley *(Petroselinum crispum)* seeds.
Study Design: Completely randomized design with 3 treatments replicated four times at different priming durations.
Place and Duration: Seed Science Laboratory - Department of Seed, Crop and Horticulture Science, University of Eldoret during May 2017.
Methodology: The treatments were hydro priming with water for 24 and 48 hours, halo priming with 2% potassium nitrate (KNO3) for 24 and 48 hours, osmopriming with 10% Polyethylene Glycol (PEG) 600 for 24 and 48 hours. After treatment the seeds were re-dried and the subjected to a germination test using blotter method in a germination chamber. Number of germinated seeds was counted on 28th day. Seedling evaluation was also done.

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Results: Hydropriming with water for 48 hours gave the highest germination percentage. Seed priming with 10% PEG gave the highest number of normal seedlings at both 24 and 48 hours. Priming with KNO3 gave the lowest germination percentage with the highest number of dead seeds and abnormal seedlings. Control had the highest number of hard seeds.
Conclusion: Farmers can improve germination of parsley seeds by hydropriming for 48 hours. This method is easy to carry out and does not require expensive chemicals like PEG. However, use of 10% PEG for priming gave the highest number of normal seedlings which are likely to survive under field conditions. Further investigations can be done on the effect of different concentrations of Potassium nitrate and PEG.

Keywords: Parsley; seed; hydropriming; osmopriming.

1. INTRODUCTION

Parsley or garden parsley (*Petroselinum crispum)* is an important vegetable, herb and spice worldwide. It is rich in calcium, thiamine, riboflavin, potassium, iron and vitamins such as A, C and niacin [1]. Health benefits of parsley include treatment of hives and other allergy symptoms as it inhibits secretion of histamine. It is also a liver tonic and helps in the breaking of kidney stones. It can reduce weight by reducing excess water gain. Parsley also has essential oils derived by steam distillation of the seeds or the above parts of the plant.

In Kenya parsley is a biennial herb sold in local and export markets earning much needed foreign exchange [2]. It provides a life line to many small scale famers who are its major producers. It is a raw material in food industry. It is also a source of employment to vendors across Kenya.

Uniformity and rapidity of seed germination and emergence are essential to increase yield, quality and profits in crops [3]. Poor stand establishment, staggered germination and slow emergence constrains production of parley in Kenya [2]. Seed germination and emergence of parsley is difficult especially under unfavorable environmental conditions. Parsley germination is slow and asynchronous with 10-28 days being allowed for the first and last count respectively [4]. It takes about 3 to 4 weeks for seedlings to germinate and emerge when parsley is grown under field conditions [2]. This has been attributed to morpho-physiological dormancy and physical dormancy where parsley seeds at maturity have premature embryos and hard seed coats.

Seed priming has been used in vegetables seeds to break morpho-physiological dormancy and enhance germination [5]. Seed pretreatment with priming reagents like water, potassium nitrate and PEG can improve germination of crops having slow germination like parsley [6]. Seed priming is a pre sowing physiological seed enhancement treatment involving controlled hydration of seeds. Hydration sufficient to allow pre-germinative metabolic activation to take place, but not sufficient to allow radical protrusion through the seed coat is done during priming [7]. This study focuses on determining the effects of priming with (hydropriming), 2% potassium nitrate (halopriming) and 10% polyethylene glycol (osmopriming) at different priming duration on percentage germination of parsley seeds. Seedling evaluation was also done to determine the effect of the treatments on seedling development. This research is of benefit in Kenya especially to small scale parsley famers who require rapidly germinating seeds even under stress condition leading to vigorous seedlings and better yields.

2. MATERIALS AND METHODS

This research was conducted at University of Eldoret, Department of Seed, Crop and Horticulture Science, Seed Science Laboratory. Parsley seedsof moss curled variety were obtained from AAA growers in Laikipia, Kenya. Moss curled varietyis a biennual herb that hasdark green, curled leaves, which grow in groups of three on a long stalk. It has a long tap root and multiple cuttings can be obtained from one plant (Smart Farming, 2015).The experiment was conducted in two stages.

2.1 Stage 1 - Seed Treatment

10% PEG solution was prepare by dissolving 21.9 grams PEG 600 in a liter of distilled water, while solution of 2% KNO3 will be prepared by dissolving 5 grams of KNO3 in a liter of distilled water. Seeds were randomly divided into 4 batches. One portion was left untreated and acted as the control. Second, third and fourth

portions were soaked in 30 ml of distilled water, 10% PEG solution and 2% KNO_3 respectively. The soaked seeds were kept in the growth chamber at 25°C. After 24 hours 400 seeds were obtained from each of the 4 portions of seeds and dried for 24 hours. They were then subjected to germination test as described in stage 2 below. After 48 hours another 400 seeds were extracted from the 4 seed portions, dried for 24 hours and subjected to germination test as described in stage 2 below.

2.2 Stage 2 Seed Germination Test

The experiment was done on a completely randomized design using 4 treatments replicated four times at different priming durations that is hydro priming with water for 24 and48 hours, halo priming with 2% KNO3 for 24 and 48 hours, osmopriming with 10% PEG 600 for 24 and 48 hours and the control. Seeds from all the treatments were then sown on 3 moist filter papers placed in petridishes. Each seed treatment had 4 replicates of 100 seeds each. For the control experiment seeds were directly sowed on moist filter paper substratum also in 4 replicates of 100 seeds each. All the petri dishes were then placed in a growth chamber set at 25°C and 70% relative humidity [8]. The substratum was kept moist by addition of small amount of water/PEG/KNO_3 (depending on the seed treatment given) every 2 days. Number of seeds that germinated was counted at 28th day.

Seedling evaluation for each of the treatment was conducted by separating the seedlings into five groups [4]. These groups were normal seedlings, abnormal seedlings, hard seeds, freshly un-germinated and dead seeds. A seed was considered to have germinated when radical emerge by about 2 mm in length [9].

Germination percentage was calculated using formula GP = n/N (where n is the number of seeds germinated and N is total number of seeds sown [5]. Data obtained was analyzed using Analysis of Variance (ANOVA) and the means were separated using Duncan Multiple Range Test (DMRT) in the GENSTAT software.

3. RESULTS AND DISCUSSION

Germination percentage of parsley seeds was significantly affected by seed priming treatments at different durations. Seedling evaluation parameters (normal seedlings, abnormal seedlings, fresh un-germinated seeds, hard and dead seeds) also differed significantly across the priming treatments and durations (Table 1). Priming with distilled water for 48 hours had the highest germination percentage compared to other treatments. Priming with 10% PEG for 48 hours had the second highest % germination and did not significantly differ from priming with water for 48 hours. This is similar to findings by other authors. Hydro priming and osmopriming with10% PEG resulted in the highest percent germination of chick pea compared to other treatments [10]. This has been attributed to activation of key enzymes such as amylases involved in germination and mobilization of storage reserves. Osmopriming (with PEG) is associated with numerous biochemical changes.

Table 1. Percentage germination and seedling evaluation parameters of different priming treatments and durations of parsley seeds

Treatment	% Germination	Normal seedlings	Abnormal seedlings	Fresh un-germinated seeds	Hard seeds	Dead seeds
Water 48 hours	56.75 a	35.25 c	21.50 b	26.25 a	10.25 de	6.75d
Water 24 hours	51.50 b	30.00 d	21.50 b	23.50 a	21.25 b	3.75e
PEG 48 hours	55.50 a	46.50 a	11.00 cd	20.50 c	11.50 d	15.75b
PEG 24 hours	51.50 b	40.05 b	9.00 d	17.25 c	16.25 c	11.75c
Control 48 hours	43.00 c	30.25 c	12.75 c	12.75 d	38.75 a	28.25a
Control 24 hours	43.00 c	30.25 c	12.75 c	12.75 d	38.75 a	27.50a
KNO_3 48 hours	38.15 d	10.75 e	28.00 a	25.25 a	10.00 de	5.50d
KNO_3 24 hours	37.25 d	9.25 e	28.00 a	23.75 a	9.25 e	5.50d
Mean	47.16	29.09	18.06	20.25	19.50	13.09
Probability	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SED	1.252	1.256	1.016	1.246	0.784	0.747
SE	1.1771	1.777	1.436	1.762	1.109	0.91
% CV	3.8	6.1	8.0	8.7	5.7	8.11

Values having the same letters within the columns are not significantly different at P≤ 0.05 (DMRT test)

In tomato a space is developed in the primed seed that facilitate water uptake therefore accelerating speed and percentage of germination [11]. Priming has also been reported to induce nuclear DNA synthesis in the radical tip cells in tomato [12]. This could also be the case for the parsley seeds in this study. Water, a component of the 2 treatments also softens the seed coat enabling the embryo to penetrate through the seed coat during germination [13]. It is important to note that best % germination in this study was 56.75% (Table 1). This quite low and could be as a result of dormancy due to immature embryo or poor storage conditions reported in parsley seeds [5].

Priming with 10% PEG for 48 hours differed significantly from all treatments in terms of normal seedlings having the highest number of normal seedlings. Priming with 10% PEG for 48 hours had significantly lower abnormal seedlings, fresh un-germinated and hard seeds than priming water for 48 hours.

High number of normal seedlings were observed in seeds primed with 10% PEG at both 24 and 48 hours is due to increased activity of key enzymes like amylase and proteases which are important in growth and development of embryo which help parsley seeds overcome embryo dormancy and help to develop normal seedlings [14].

Priming with 2% KNO_3 at 24 and 48 hours had significantly lower % germination than control setup and the highest abnormal seedlings compared to all the treatments. This was similar to research done by [15]. Who found that priming pansy seeds in such a concentration for 6- 24 hours in most cases reduced their germination percentage. This is due to the low molecular size of the salt which may be absorbed by the seed, resulting to toxic effects [16]. This also can reason why there was a large number of abnormal seedlings in seeds primed using 2% KNO3 at both 24 and 48 hours in the current study. PEG is the most recommended osmoticum by many in researches due to the large sizes of its molecules which do not enter the seed living cells. This is in line with the results obtaining by priming with 10% PEG at 24 and 48 hours which resulted to high germination percentage and healthy seedlings.

Control differed significantly from the rest in terms of hard seeds with the highest number of hard seeds (Table 1). High number of hard seeds observed on unprimed seeds or control is due to seed coat dormancy a characteristic of parsley seeds that restricts imbibition.

4. CONCLUSION

In conclusion seed priming is of advantageous to parsley seeds as it improved percent germination and amount of normal transplantable seedling. Seed priming with 2% KNO3 for 24 and 48 hours negatively affected seed germination of parsley resulting to high number of dead and abnormal seedlings as well as lower percent germination. For successive seed priming factors such as priming duration and concentration of priming material should be taken in to concern. As shown by hydro priming with distilled water at 48 hours gave the best results in terms of germination percentage than hydropriming at 24 hours. Priming with 10% PEG for 48 hours also gave a better germination percentage and the highest number of normal seedlings than 10% PEG for 24 hours. This study therefore recommends priming of parsley seeds before sowing so that the famer can obtain a higher germination percentage at a faster rate with vigorous seedlings for a health crop stand which intern will bumper the harvest. Recommended priming treatment and duration for proper performance of parsley at germination are hydropriming with distilled water for 48 hours and osmopriming with Poly ethyl glycol (10% PEG) for 48 hours. More research required is to ascertain the best concentration and the best priming duration if KNO_3 is be used in seed priming on parsley seeds. Further study should also be done to ascertain and verify the most appropriate priming method in parsley under field conditions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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