

Original Research Article

PERCENTAGE GERMINATION AND SEEDLING EVALUATION PARAMETERS OF PARSLEY(*PETROSELINIUM CRISPUM*) SEEDS AS AFFECTED BY DIFFERENT PRIMING TREATMENTS AND DURATIONS

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 (KNO_3) 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 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.

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 KNO_3 gave the lowest germination percentage with the highest number of dead seeds and abnormal seedlings. Control had the highest number of hard seeds.

21 Conclusion: Farmers can improve germination of parsley seeds by hydropriming for 48 hours.
22 This method is easy to carry out and does not require expensive chemicals like PEG. However,
23 use of 10% PEG for priming gave the highest number of normal seedlings which are likely to
24 survive under field conditions. Further investigations can be done on the effect of different
25 concentrations of Potassium nitrate and PEG.

26 **Keywords:** Parsley; Seed; Hydropriming; Osmopriming;

27 INTRODUCTION

28 Parsley or garden parsley (*Petroselinum crispum*) is an important vegetable, herb and spice
29 worldwide. It is rich in calcium, thiamine, riboflavin, potassium, iron and vitamins such as A, C
30 and niacin (Guenwald, 1998). Health benefits of parsley include treatment of hives and other
31 allergy symptoms as it inhibits secretion of histamine. It is also a liver tonic and helps in the
32 breaking of kidney stones. It can reduce weight by reducing excess water gain. Parsley also has
33 essential oils derived by steam distillation of the seeds or the above parts of the plant.

34 In Kenya parsley is a biennial herb sold in local and export markets earning much needed foreign
35 exchange (Smart farming Kenya, 2015). It provides a life line to many small scale famers who are
36 its major producers. It is a raw material in food industry. It is also a source of employment to
37 vendors across Kenya.

38 Uniformity and rapidity of seed germination and emergence are essential to increase yield,
39 quality and profits in crops (Cantliffe, 2003). Poor stand establishment, staggered germination
40 and slow emergence constrains production of parley in Kenya (Smart farming Kenya, 2015).
41 Seed germination and emergence of parsley is difficult especially under unfavorable
42 environmental conditions. Parsley germination is slow and asynchronous with 10-28 days being

43 allowed for the first and last count respectively (AOSA, 1991). It takes about 3 to 4 weeks for
44 seedlings to germinate and emerge when parsley is grown under field conditions (Smart Farming
45 Kenya, 2015). This has been attributed to morpho-physiological dormancy and physical
46 dormancy where parsley seeds at maturity have premature embryos and hard seed coats.

47 Seed priming has been used in vegetables seeds to break morpho-physiological dormancy and
48 enhance germination (Pirasteh-Anosheh & Hamidi, 2013). Seed pretreatment with priming
49 reagents like water, potassium nitrate and PEG can improve germination of crops having slow
50 germination like parsley (Ibrahim, 2016). Seed priming is a pre sowing physiological seed
51 enhancement treatment involving controlled hydration of seeds. Hydration sufficient to allow
52 pre-germinative metabolic activation to take place, but not sufficient to allow radical protrusion
53 through the seed coat is done during priming (Nascimento & Arango, 2004). This study focuses
54 on determining the effects of priming with (hydropriming), 2% potassium nitrate (halopriming)
55 and 10% polyethylene glycol (osmopriming) at different priming duration on percentage
56 germination of parsley seeds. Seedling evaluation was also done to determine the effect of the
57 treatments on seedling development. This research is of benefit in Kenya especially to small
58 scale parsley famers who require rapidly germinating seeds even under stress condition leading
59 to vigorous seedlings and better yields.

60 **Materials and methods**

61 This research was conducted at University of Eldoret, Department of Seed, Crop and
62 Horticulture Science, Seed Science Laboratory. Parsley seeds of moss curled variety were
63 obtained from AAA growers in Laikipia, Kenya. Moss curled variety is a biennial herb that
64 has dark green, curled leaves, which grow in groups of three on a long stalk. It has a long tap root

65 and multiple cuttings can be obtained from one plant (Smart Farming, 2015).The experiment was
66 conducted in two stages.

67 **Stage 1 - Seed treatment**

68 10% PEG solution was prepare by dissolving 21.9 grams PEG 600 in a liter of distilled water,
69 while solution of 2% KNO₃ will be prepared by dissolving 5 grams of KNO₃ in a liter of
70 distilled water. Seeds were randomly divided into 4 portions. One portion was left untreated and
71 acted as the control. Second, third and fourth portions were soaked in 30 ml of distilled water,
72 10% PEG solution and 2% KNO₃ respectively. The soaked seeds were kept in the growth
73 chamber at 25⁰C. After 24 hours 400 seeds were obtained from each of the 4 portions of seeds
74 and dried for 24 hours. They were then subjected to germination test as described in stage 2
75 below. After 48 hours another 400 seeds were extracted from the 4 seed portions, dried for 24
76 hours and subjected to germination test as described in stage 2 below.

Comment [11]: I prefer batches to portions

77 **Stage 2 Seed germination test**

78 The experiment was done on a completely randomized design using 4 treatments replicated four
79 times at different priming durations that is hydro priming with water for 24 and 48 hours, halo
80 priming with 2% KNO₃ for 24 and 48 hours, osmopriming with 10% PEG 600 for 24 and 48
81 hours and the control. Seeds from all the treatments were then sown on 3 moist filter papers
82 placed in petridishes. Each seed treatment had 4 replicates of 100 seeds each. For the control
83 experiment seeds were directly sowed on moist filter paper substratum also in 4 replicates of 100
84 seeds each. All the petri dishes were then placed in a growth chamber set at 25⁰C and 70%
85 relative humidity (ISTA, 2004). The substratum was kept moist by addition of small amount of

86 water/PEG/KNO₃ (depending on the seed treatment given) every 2 days. Number of seeds that
87 germinated was counted at 28th day.

88 Seedling evaluation for each of the treatment was conducted by separating the seedlings into five
89 groups (AOSA, 1991). These groups were normal seedlings, abnormal seedlings, hard seeds,
90 freshly un-germinated and dead seeds. A seed was considered to have germinated when radical
91 emerge by about 2mm in length (Pirasteh, et. al, 2011)

92 Germination percentage was calculated using formula $GP = n/N$ (where n is the number of seeds
93 germinated and N is total number of seeds germinated (Pirasteh-Anosheh & Hamidi, 2013). Data
94 obtained was analyzed using Analysis of Variance (ANOVA) and the means were separated
95 using Duncan Multiple Range Test (DMRT) in the GENSTAT software.

Comment [I2]: N should be the total number of seeds sown but not germinated

96 RESULTS AND DISCUSSION

97 Germination percentage of parsley seeds was significantly affected by seed priming treatments at
98 different durations. Seedling evaluation parameters (normal seedlings, abnormal seedlings,
99 fresh un-germinated seeds, hard and dead seeds) also differed significantly across the priming
100 treatments and durations (Table 1). Priming with distilled water for 48 hours had the highest
101 germination percentage compared to other treatments. Priming with 10% PEG for 48 hours had
102 the second highest % germination and did not significantly differ from priming with water for 48
103 hours. This is similar to findings by other authors. Elkoca, et al., 2007 reported that hydro
104 priming and osmopriming with 10% PEG resulted in the highest percent germination of chick pea
105 compared to other treatments. This has been attributed to activation of key enzymes such as
106 amylases involved in germination and mobilization of storage reserves. Osmopriming (with
107 PEG) is associated with numerous biochemical changes. In tomato a space is developed in the

108 primed seed that facilitate water uptake therefore accelerating speed and percentage of
109 germination (Argerich, 1989). Priming has also been reported to induce nuclear DNA synthesis
110 in the radical tip cells in tomato (Liu, et al, 1997). This could also be the case for the parsley
111 seeds in this study. Water, a component of the 2 treatments also softens the seed coat enabling
112 the embryo to penetrate through the seed coat during germination (Bweley and Black, 1994). It
113 is important to note that best % germination in this study was 56.75% (Table 1). This quite low
114 and could be as a result of dormancy due to immature embryo that has been reported in parsley
115 seeds (Pirasteh-Anosheh & Hamidi, 2013).

Comment [13]: It could also due to poor storage

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

120 | **Table 1 Percentage Germination and Seedling Evaluation Parameters of Different Priming**
121 | **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

122 Values having the same letters within the columns are not significantly different at $P \leq 0.05$
123 (DMRT test).
124

125 High number of normal seedlings were observed in seeds primed with 10% PEG at both 24 and
126 48 hours is due to increased activity of key enzymes like amylase and proteases which are
127 important in growth and development of embryo which help parsley seeds overcome embryo
128 dormancy and help to develop normal seedlings (Kaur, et al., 2005).

129 | Priming with 2% KNO₃ at 24 and 48 hours had significantly lower % germination than control
130 setup and the highest abnormal seedlings compared to all the treatments. This was similar to
131 research done by (Rajabalipour, et al, 2013) who found that priming pansy seeds in such a
132 concentration for 6- 24 hours in most cases reduced their germination percentage. Bradford,
133 1995, reported that this is due to the low molecular size of the salt which may be absorbed by the
134 seed, resulting to toxic effects. This also can reason why there was a large number of abnormal
135 seedlings in seeds primed using 2% KNO₃ at both 24 and 48 hours in the current study. PEG is
136 the most recommended osmoticum by many in researches due to the large sizes of its molecules
137 which do not enter the seed living cells. This is in line with the results obtaining by priming with
138 10% PEG at 24 and 48 hours which resulted to high germination percentage and healthy
139 seedlings.

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

143 | **Conclusion**

144 | In conclusion seed priming is of advantageous to parsley seeds as it improved percent
145 germination and amount of normal transplantable seedling. Seed priming with 2% KNO₃ for 24
146 and 48 hours negatively affected seed germination of parsley resulting to high number of dead
147 and abnormal seedlings as well as lower percent germination. For successive seed priming
148 factors such as priming duration and concentration of priming material should be taken in to
149 concern. As shown by hydro priming with distilled water at 48 hours gave the best results in
150 terms of germination percentage than hydropriming at 24 hours. Priming with 10% PEG for 48
151 hours also gave a better germination percentage and the highest number of normal seedlings than
152 10% PEG for 24 hours. This study therefore recommends priming of parsley seeds before
153 sowing so that the farmer can obtain a higher germination percentage at a faster rate with
154 vigorous seedlings for a health crop stand which intern will bumper the harvest. Recommended
155 priming treatment and duration for proper performance of parsley at germination are
156 hydropriming with distilled water for 48 hours and osmopriming with Poly ethyl glycol (10%
157 PEG) for 48 hours. More research required is to ascertain the best concentration and the best
158 priming duration if KNO₃ is be used in seed priming on parsley seeds. Further study should also
159 be done to ascertain and verify the most appropriate priming method in parsley under field
160 conditions.

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