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# Effect of seed priming on germination indices of Flixweed (*Descurainia Sophia L*.) in drought condition

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**ABSTRACT:** Seed priming is a method that can be used to advance germination and growth in stressful conditions. In this study we investigated the effect of seed priming with gibberellic acid in two concentration (25ppm and 50ppm), KCl (0.5 M) and CaCl2 (0.5 M) in drought stress condition on Flixweed (Descurainia Sophia L.) seeds. An experiment was carried out using factorial experiment in randomize complete design with three replications. Germination indices including final germination percentage (FGP), the coefficient of velocity of germination (CVG), Germination rate index (GRI), the mean germination time (MGT), Germination speed (GS) and the mean of daily germination (MDG). Results of this experiment indicate that drought stress reduced all germination indices. In non-stressed conditions GA3 treatment has improved germination index and GA3:50ppm was better than GA3:25ppm. In stressful conditions CaCl2 treatment has better effect than other treatments and also GA3:50ppm was in second level. According to our results the effect of KCL was not significant and this treatment could not improve germination indices.

***Keywords*:** Descurainia Sophia, Gibberellic acid, Germination indices, Drought stress

## INTRODUCTION

Flixweed *(Descurainia Sophia* L.*)* is an annual and biannual herb with one meter height from cruciferae family, the seed is considered to have a role in a tonic for the heart, that are locally soothing and softening, fever reducing, and removing mucous secretions from lungs. Some dried-oil can be obtained from the seed, It is leaves are stored with corn to prevent from spoilage (Zargari, 2008). *D. sophia* is used in medicine such as remedy for throat disease, measles, and smallpox (Bekker, N.P 2005). Seeds of *D.sophia* is widely distributed in northern China, and used traditionally in Chinese medicine to relieve cough, prevent asthma, reduce edema, and promote urination (Sun 2006). Previous work has been undertaken on this plant and it shows that it contains various types of secondary metabolites, such as glucosinolates, cardiacglycosides, flavonoids, lactones, lipids, sulfurglycoside, orlignan, coumarins, allyl and benzyl isothiocyanates and β-sitoterol with biological effects (Sun, K 2006).

Seed priming is a method that can be used to advance germination and growth in stressful conditions. During priming, the germination process is persuaded by soaking seeds in water (Khan et al. 2009). Primed seeds incline to demonstrate better germination and growth even when put into stressful conditions, though during the priming how the mechanism advances these parameters are unclear, it has been optional that the strategy activates a series of physiological processes that advance plant growth under stressful conditions (Varier et al. 2010). Another method of seed priming is that used to reduce the emergence time, to get coordinated emergence, to improve emergence rate, and to have better seedling stand in many agricultural systems (Rudrapal and Nakamura1998; Bradford et al. 1990; Khan 1992; Jett et al. 1996).

Priming enhances seed performance initiating the early events of germination up to but still below threshold of cell devision (Gurusingheet al. 1999). Metabolic changes that take place during priming are not enough to induce radicle protrusion (McDonald 2000). Enhancement of germination percentages was achieved in response to seed priming in some vegetable crops (Suzuki and Khan 2000) and flower species (Canliffe 1997). The rate of germination (inverse of time to germinate) and improvement of seedling stands were also accelerated as a result of seed priming in tomato (Corbineau et al.2000), pepper (Lee et al.1997), as well as carrot, lettuce, and onions (Jeong et al.2000b). Variation in the results depended on temperature, priming duration, concentration of the priming chemical, and the crop type (Jeong et al.2000 c & d). The opportunity to gain best results with seed priming has inspired investigation in to the physiological principles controlling this process. Considerable evidences confirm the repair of DNA, RNA, protein, membranes and enzymes occurrence during imbibition (McDonalds 2000). Other studies, however, suggest that the maximum beneficial effects of priming are achieved during the drying phase, when enzymes and antioxidant are afforded sufficient time to repair and physiologically stabilize the seed (Dell Aquila and Tritto 1991).

Plant growth regulators are organic compounds, which are produced in very small amount in plants and play an important role in growth and development and yield of crops and are becoming quite popular in field of agriculture. Gibberellic Acid ($GA_3$) is the most important growth regulator, which breaks seed dormancy, promotes germination, intermodal length, hypocotyl growth and cell division in cambial zone and increases the size of leaves. $GA_3$ stimulates hydrolytic enzymes that are needed for the degradation of the cells surrounding the radicle and thus speeds germination by promoting seedling elongation growth of cereal seeds (Rood *et al*., 1990). Larissa et al. (2014) found that the priming treatments with hormone and water has improved the germination indices of pigeon pea under cadmium stress in compared to non-treated seeds. Chauhan et al. (2009) reported that the significant variation was found between the Black gram and Horse gram seeds that were soaked in different concentrations of $GA_3$ and IAA for 24 hours, in all aspects. $GA_3$ (10 ppm) showed highest germination percentage as well as the higher radicle and plumule length in contrast to other treatments. But when considered particularly on the radicle and plumule elongation, these did not show any significant effect on both the crop species. The aim of this paper was to examine whether priming with mineral salts carrier and pretreatment with GA3 results in enhancement of seed germination indices in Hedge-mustard and to find out an effective seed priming treatment for Hedge-mustard under drought conditions and to evaluate the germination indices changes induced by these treatments.

**MATERIALS AND METHODS**

Factorial experiment in randomized complete design with three replications and two factors including Seed priming with 5 treatment (GA3:25 ppm, GA3:50 ppm, KCL: 0.5M, $CaCl_2$: 0.5M and Control) and draught stress (control, -5 MP) draught stress made by polyethylene Glycol (PEG) for decrease water potential, was conducted to determination the effect of seed priming on germination indices in Flixweed (*Descurainia sophia* L.).

Seeds were soaked in ratio of 1:4 seeds and treatment solution for 24h. At the end of priming treatments the seeds were rinsed thoroughly by distilled water and re-dried to original weight under shade (Sundstrom et al., 1987). 50 seeds were planted in each Petri dish. Germination tests were performed in lab condition within 7 days. In order to measure the germination indices, germinated seeds were counted daily. In the last day, Germination indices and seedling growth including final germination percentage (FGP), the coefficient of velocity of germination (CVG), the mean germination time (MGT), Germination speed (GS) And the mean of daily germination (MDG) were calculated using the following formulas:

1) The coefficient of velocity of germination (CVG):

$CVG = 100 \times \sum Ni / \sum NiTi$

Ni = Number of germinated seeds per day

Ti = Number of days from the start of the experiment

2) Germination rate index (GRI):

$GRI = G1 / 1 + G2 / 2 + \ldots. + Gx / X$

G1 = Germination percentage at first day

G1 = Germination percentage at the second day and so on

The mean of germination time (MTG): (Almudaris, 1998)

$MGT = \sum NiTi / \sum Ni = 100 / CVG$

Ni = Number of seeds germinated per day

Ti = Number of days from the starting the experiment

3) The final germination percentage (FGP): (Andalibi et al. 2005 and Gharineh et al.2004)
FGP = Ng / Nt × 100

Ng = Total number of seeds germinated
Nt = Total number of seeds evaluated

4) Germination speed (GS) was calculated according to the method of Magour:

GS = ∑ Si / Di
Si = Number of seeds germinated at $i^{th}$ day
Di = Number of days to counting nth

5) Mean daily germination (MDG) that is an indicator from daily germination was calculated from the following equation:

MDG = FGP/d
FGP = Final germination percentage (viability)
d = Number of days to reach the maximum final germination

Germination was defined as the visible emergence of the radicle through the seed coat (Maguire1962, Galmés et al. 2006).

Data was subjected to (ANOVA) using MSTATC program and means were compared using Duncan multiple Range test.

## RESULT AND DISCUSSION

The result of analyses of variance (ANOVA) (table1), shows that the effect seed priming and drought stress on studied parameters was significant. Results of the comparison of the means of seed priming and drought stress shows that our treatments were effective and they improved germination indices.

Table1: Analysis of variance (ANOVA) for germination indices of Flixweed, affected by seed priming in drought stress condition.

| | | MS | | | | | |
|---|---|---|---|---|---|---|---|
| Source | df | FGP | CVG | GRI | MGT | GS | MDG |
| Priming | 4 | 489.2** | 8.786ns | 9.734** | 0.193ns | 15.944** | 6.946** |
| stress | 1 | 6049.2** | 22.757ns | 192.128** | 0.486* | 233.077** | 110.285** |
| Priming×stress | 4 | 205.867** | 8.688ns | 6.657** | 0.164ns | 10.105** | 3.17** |
| Error | 20 | 10 | 4.266 | 0.306 | 0.082 | 0.748 | 0.383 |
| cv | | 4.83% | 7.93% | 5.52% | 7.41% | 7.77% | 6.38% |

ns: non-significant, *: significant at P=0.05, **: significant at P=0.01

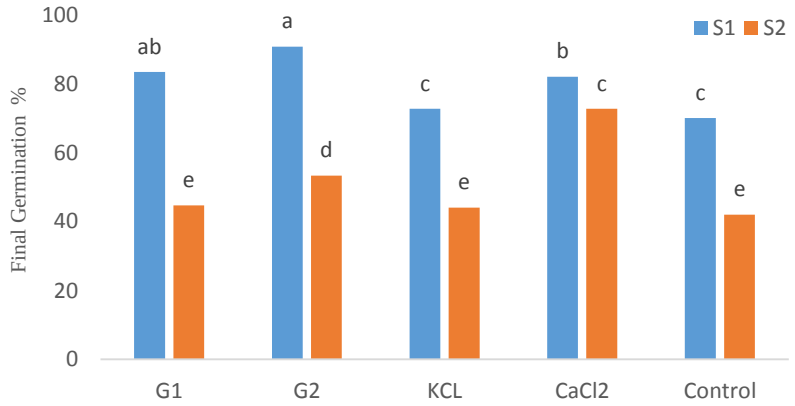

Figure1: effect of seed priming (G1: GA3 (25ppm), G2: GA3 (50ppm), KCl (0.5M), CaCl2 (0.5M) and control (non-primed) on final germination percentage (FGP) in drought stress (S1: without stress and S2: drought stress in -5Mp) in Flixweed. different letters indicate statistically significant difference at P=0.01

Mean comparison of final germination percentage (FGP) (figure1), shows that drought stress decreased final germination percentage in all treatments. In non-stressed conditions (S1), G1, G2 and CaCl2 were significant in comparison with control treatment. And also the higher level of germination was in G2 treatment. In drought stress condition (S2) seed priming with $GA_3$ 50ppm (G2) and CaCl2 was statistically significant in comparison with non-primed seed and also CaCl2 treatment has better effect than G2 treatment.

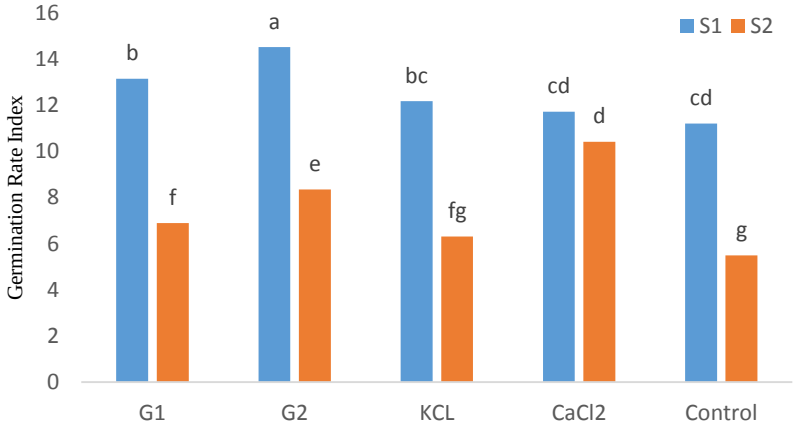


Figure2: effect of seed priming (G1: $GA_3$ (25ppm), G2: $GA_3$ (50ppm), KCl(0.5M), $CaCl_2$(0.5M)and control (non-primed) on germination rate index (GRI) in drought stress (S1: without stress and S2: drought stress in -5Mp) in Flixweed. different letters indicate statistically significant difference at P=0.01

Figure2, shows that in non-stress conditions (S1), G1 and G2 treatments were significant when compared with control treatment, the effect of hormone (Gibberellic acid) cause an increase in germination rate index, but KCl and $CaCl_2$ has not-significant effect on this parameter. Also G2 has better effect than G1 for germination rate index. In drought stress (S2), only KCL was non-significant in comparison with control treatment but G1, G2, and $CaCl_2$ were significant and this treatment increased this parameter. Also in S1 condition germination index was higher than S2 condition.

Mean comparison of Germination speed data's (figure3) show that G1 in S1 condition was significant but in S2 condition was non-significant when compared with each control treatment. G2 in S1 condition and S2 condition was significant and G2 in S1 condition was more effective on germination speed. Seed treatment with KCl in S1 and S2 condition was non-significant for germination speed. Also priming with $CaCl_2$ in S1 condition was non-significant but in S2 condition it was significant and statistically improved this parameter.

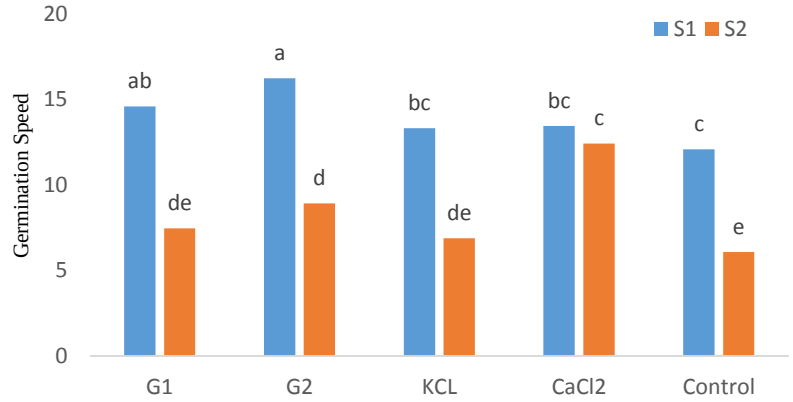

Figure3: effect of seed priming (G1: $GA_3$ (25ppm), G2: $GA_3$ (50ppm), KCl (0.5M), $CaCl_2$ (0.5M)and control (non-primed) on Germination speed (GS) in drought stress (S1: without stress and S2: drought stress in -5Mp) in Flixweed. different letters indicate statistically significant difference at P=0.01

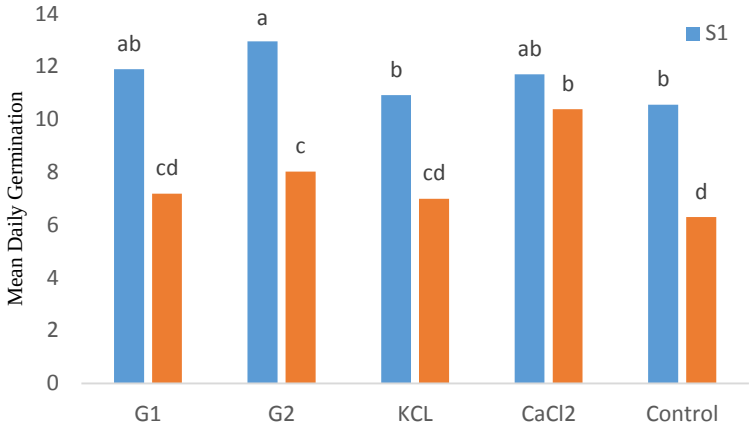


Figure4: effect of seed priming (G1: $GA_3$ (25ppm), G2: $GA_3$ (50ppm), KCl (0.5M), $CaCl_2$ (0.5M) and control (non-primed) on Mean daily germination (MDG) in drought stress (S1: without stress and S2: drought stress in -5Mp) in Flixweed. different letters indicate statistically significant difference at P=0.01

According to the figure 4, just $GA_3$ 50ppm in S1 condition was significant and has better effect than another treatment to increase mean daily germination, G1, KCl and $CaCl_2$ was non-significant in comparison with control treatment. In S2 condition G2 and $CaCl_2$ were significant and $CaCl_2$ treatment was more effective than G2 to increase mean daily germination but G1 and KCl were non-significant in S2 condition.

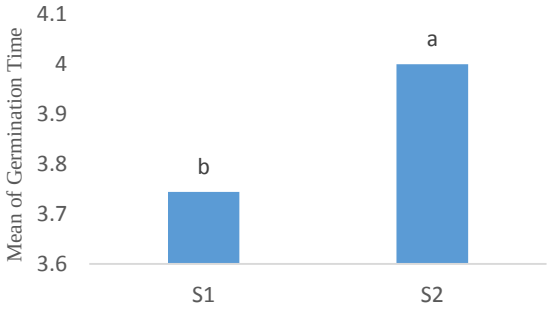


Figure5: The effect of drought stress (S1: without stress and S2: drought stress in -5Mp) on mean of germination time (MGT) in Flixweed, Different letters indicate statistically significant difference at P=0.05

Our results shows that Flixweed's seeds in drought condition needs more time for germination in comparison with sufficient Water access condition because when seeds can easily absorb water, physiological functions quickly occur in seed and in less time they can germinate. But in S2 condition, the seeds can not to absorb water easily and germination process needs more time.

It's reported that seed priming with auxin, cytokinin, gibberellin, abscisic acid and ethylene, enhanced germination indices and alters the physiological responses of seeds and seedling characteristics in pigeon pea (Larissa et al. 2015), Seed priming treatments in coarse rice improved the nursery seedlings, which resulted in improved growth, yield and quality of the produce, Osmohardening (KCl) performed better than all other treatments, followed by osmohardening (CaCl2), hardening and ascorbate priming(Farooq and Basra 2009), Seed germination and seedling growth can be influenced by various concentrations of growth regulators i.e. GA3 and IAA in Black gram and Horse gram (Chauhan et al. 2009). And also they reported that the effect of seed priming on these crops was significant and our results confirmed their work.

## CONCLUSION

Our results suggest Flixweed (*Descurainia Sophia* L.*)* can be enhanced to germination indices when treated with different priming techniques. The present results also confirm that drought stress reduced all germination indices. In non-stress condition $GA_3$ treatments was improved germination indices and $GA_3$:50ppm was better than $GA_3$:25ppm. In stress full condition, $CaCl_2$ treatment was better than other treatments and also $GA_3$:50ppm was in second level. According to our result the effect of KCl was not significant and this treatment could not improve germination indices.

According to our results and previews researches, it's suggested that hormonal priming would be test on such medicinal plants to study the effect of pre-sowing treatment on physiological and especially on chemical composition of the plants

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