DORMANCY STUDIES ON Euphorbia dracunculoides AND Astragalus spp.: MAJOR WEEDS OF ARID AREAS

Estudos sobre Dormência de Euphorbia dracunculoides e Astragalus spp.: Principais Ervas Daninhas das Zonas Áridas

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ABSTRACT - The aim of this study was to examine the dormancy behavior of Euphorbia dracunculoides and Astragalus spp., weeds of arid chickpea. The dormancy breaking treatments were: Gibberalic acid (GA) and Thiourea each at 50, 100, 150, 200, 250, and 300 ppm and Potassium nitrate (KNO3) at 5,000, 10,000, 15,000, 20,000, 25,000, and 30,000 ppm (24 h soaking). Germination (G) percentage and germination energy (GE) of E. dracunculoides was maximum (89 and 22, respectively) at 250 ppm concentration of GA3 and 81.50 and 11.50 at 15000 ppm concentration of KNO3. Thiourea at 250 and 300 ppm resulted in maximum G percentage (51) and GE (25.50) of E. dracunculoides, whereas the G percentage and GE of Astragalus spp. were maximum (28 and 19, respectively) at the lowest concentration of GA3 (50 ppm). On the other hand, 5000 ppm and 150 ppm concentration of KNO3 and Thiourea showed maximum GE (19.5) and G percentage (28) of Astragalus spp., respectively. Overall, effective dormancy breaking chemical against E. dracunculoides was GA (250 ppm) while in Astragalus spp. none of chemicals showed very impressive results. These results showed that both weeds’ seeds have dormancy in their habit. Hot water treatment and the above mentioned chemicals (best concentrations) when used with 4, 8, and 12 hours soaking showed ineffective results.

Keywords: GA3, KNO3, thiourea, dormancy, E. dracunculoides, and Astragalus spp.

RESUMO - O objetivo deste estudo foi analisar o comportamento de dormência de Euphorbia dracunculoides e Astragalus spp., ervas daninhas de grão de bico árido. Tratamentos de quebra da dormência foram: ácido Gibberalic (GA) e tioureia cada a 50, 100, 150, 200, 250 e 300 ppm e de nitrito de potássio (KNO3) em 5.000, 10.000, 15.000, 20.000, 25.000 e 30.000 ppm (24 horas de imersão). Germinação (G) e porcentagem de energia de germinação (GE) de E. dracunculoides foi máxima (89 e 22, respectivamente) a 250 ppm de concentração de GA, e 81,50 e 11,50 a 15000 ppm de concentração de KNO3. Thiourea a 250 e 300 ppm resultou em percentagem máxima de L (51) e GE (25,50) de E. dracunculoides. Considerando G porcentagem e GE de Astragalus spp. foi máxima (28 e 19, respectivamente), a menor concentração de GA3 (50 ppm). Por outro lado, de 5000 ppm e 150 ppm de concentração de KNO3 e tioureia mostrou máximo GE (19,5) e G percentagem (28) do Astragalus spp., respectivamente. Acima de tudo, quebrando a dormência química eficaz contra E. dracunculoides foi GA (250 ppm), enquanto em Astragalus spp., nenhum dos produtos químicos mostraram resultados impressionantes. Estes resultados mostraram que ambas as ervas daninhas sementes apresentam dormência em seu hábito. Tratamento de água quente e produtos químicos acima mencionados (melhores concentrações) quando usado com 4, 8 e 12 horas de imersão apresentaram resultados ineffectives.


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INTRODUCTION

Worldwide, of all the species of plants, only 3% are weeds and among them only 200-250 are said to be a major problem. Weeds are characterized by many factors i.e. abundant seed production, rapid population establishment, seed dormancy, long-term survival of buried seed, adaptation for spread, presence of vegetative reproductive structures and ability to occupy sites disturbed by humans (Lingenfelter & Hartwig, 2013) that make them stronger to compete or invade.

Dormancy is a common feature of many weed seeds (Roberto et al., 2000) that describe the conditions in which the seed is able to germinate (Finch-Savage & Leubner-Metzger, 2006). Germination of weed seeds has been under great influence of growth hormones like GA₃, KNO₃, Thiourea and sodium azide to break seed dormancy (Vieira et al., 2002; Cetinbas & Koyuncu, 2006; Khan & Shah, 2011). The effective (GA₃) and ineffective (Thiourea and KNO₃) behavior at different concentrations on different plant seeds has been reported by Vieira et al. (2002) and Ali et al. (2011).

Dormancy is of different kinds and its understanding is of ecological importance. This information can be used for management programs and species reintroduction (Koyuncu, 2005; Ortega-Base & Rojas-Arechiga, 2007). The dormancy behavior of weed seeds helps them to dodge weeding practices such as herbicides and makes them successful in persisting in the agro-ecosystem (Tang et al., 2008; Khan & Shah, 2011). Efficient crop production can be achieved by assisting the new methods of dormancy release (Gu et al., 2004).

Euphorbia dracunculoides and Astragalus spp. are major annual and broad leave leaf weeds of rain fed chickpea-chickpea mono cropping system in Pakistan, and chickpea is grown from October to April on sandy soils in moisture conserved during summer rains. Euphorbia dracunculoides and Astragalus spp. germination, emergence and persistence have not been described for the arid environment. Worldwide, there is a lack of literature on comprehensive study of the seed dormancy problems of E. dracunculoides and Astragalus spp. Therefore, the objective of the present investigation was to determine the efficiency of gibberellic acid (GA₃), potassium nitrate (KNO₃) and Thiourea at different concentrations to overcome dormancy in E. dracunculoides and Astragalus spp.

MATERIALS AND METHODS

Seed collection

The mature seeds of E. dracunculoides and Astragalus spp. were collected using the random sampling technique in 2009 from southern arid areas of Pakistan. Immediately after collection, the seeds were isolated from the fruits and then separated from the undesired materials and unripe seeds on arrival at the laboratory. The seeds were stored in sealed paper bags after drying for a week in the shade under normal laboratory conditions (25 to 30 °C). Only mature and uniform sized seeds were used in the experiments.

Experiment 1: Effect of GA₃, KNO₃ and Thiourea on breaking the seed dormancy of Euphorbia dracunculoides and Astragalus spp.

The seeds of both species were soaked in different concentrations of GA₃ and Thiourea (50 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm) and KNO₃ (5,000 ppm, 10,000 ppm, 15,000 ppm, 20,000 ppm, 25,000 ppm and 30,000 ppm) for 24 hours at 18 °C for each species separately.

Experiment 2: Effect of hot water treatment on breaking the seed dormancy of Euphorbia dracunculoides and Astragalus spp.

The seeds of both species were soaked in different concentrations of GA₃ and Thiourea (50 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm) and KNO₃ (5,000 ppm, 10,000 ppm, 15,000 ppm, 20,000 ppm, 25,000 ppm and 30,000 ppm) for 24 hours at 18 °C for each species separately.

Germination test

After rinsing, the seeds were allowed to sun dry on the blotter paper at 19 °C before...
Dormancy studies on *Euphorbia dracunculoides* and *Astragalus* spp.

placing them in Petri dishes in the above stated experiments. Petri dishes with a 9 cm diameter were washed with a 5% sodium hypochlorite (NaOCl) solution for 5 min and subsequently rinsed five times with sterilized water. After drying, the petri dishes were subjected to sterilization in an ultraviolet machine for 2 minutes. Seeds were placed on double layered Watt man No. 10 filter paper moistened with 5 mL of distilled water in sterilized Petri dishes after each treatment. All dishes were sealed with a strip of paraffin to reduce water loss (Nadjafi et al., 2006) and placed at room maximum (20 °C) and minimum temperature (17 °C). A completely randomized design for each experiment with four replications was used and 25 seeds were assigned per replicate. Germination counts were made every day for 2 weeks. Seeds were considered to be germinated when the tip of the radical (2 mm) had grown free of the seed coat (Auld et al., 1988). Each experiment was carried out twice and statistical analysis was performed on the mean of the two replicates. The G percentage was calculated by the following formula as described by Association of Official Seed Analysis (AOSA, 1990):

\[
\text{Germination percentage} = \frac{\text{Germinated seeds}}{\text{Total seeds}} \times 100
\]

\[
\text{Germination energy} = \frac{\text{Seeds count on } 4^{\text{th}} \text{ day}}{\text{Total seeds}} \times 100
\]

The data collected were analyzed by using the Fisher’s analysis of the variance function of MSTAT statistical computer package and LSD at 5% probability was used to compare the treatment’s means (Steel et al., 1997).

**RESULTS AND DISCUSSION**

**Effect of GA₃ on the germination percentage and germination energy of *Euphorbia dracunculoides* and *Astragalus* spp.**

Effect of the GA₃ on G percentage and GE of *E. dracunculoides* showed significantly different results than not soaked (control) and seeds soaked in distilled water (Figures 1 and 2). All GA₃ concentrations increased the G percentage and GE of *E. dracunculoides* gradually from low concentration to higher concentrations up to a 250 ppm (89) and then decline (82) a little bit at the highest concentration (300 ppm) but were much more than the not soaked (control) and distilled water treated seeds. However, the opposite results were observed in *Astragalus* spp. The lowest concentration of GA₃ (50 ppm) resulted in the maximum G percentage (28) and GE (19) of *Astragalus* spp. Both G percentage and GE decreased with increased GA₃ concentration. The results of the distilled water treated seeds were statistically at par with those of 50 ppm GA₃ treated seeds.

![Graph](image)

**Figure 1** - Effect of GA₃ on the seed germination percentage of *E. dracunculoides* and *Astragalus* spp.

NS = not soaked, DW = distilled water.
NG = not germinated, NS = not soaked, DW = distilled water.

**Figure 2** - Effect of GA$_3$ on the seed germination energy of *Euphorbia dracunculoides* and *Astragalus* spp.

_Euphorbia dracunculoides_ germination results in our study are similar to those of Karam & Al-Salem (2001) and Rahman et al. (2006) who reported that a 250 ppm concentration of GA$_3$ gave maximum G (31.67 and 86%) in *Allium sativum* and *Arbutus andrachne*, respectively. In contrast, Koyuncu (2005) and Ghahfarokhi & Afshari (2007) noted that 1,000 ppm GA$_3$ application proved more effective against black mulberry than any of other GA$_3$ concentration (0, 250, 500, 1,000 and 2,000 ppm) but an increase in concentration resulted in an increase in G percentage. In *Astragalus* spp, contradictory results were reported by Keshtkar et al. (2008) whose study revealed that maximum G (81%) of *Astragalus cyclophyllon* was achieved when the seeds were treated with a 500 ppm concentration of GA$_3$. But the results of Khan et al. (2002) showed no significant effect of GA$_3$ concentrations (50, 300 and 500 ppm) on final G percentage of grape fruit (*C. paradisi*) and kiinnow mandarin (*C. reticulate*). Controversial results may be due to the species difference.

**Effect of KNO$_3$ on germination percentage and germination energy of *Euphorbia dracunculoides* and *Astragalus* spp.**

The germination percentage and GE of *E. dracunculoides* was maximum (81.50 and 11.50, respectively) at 15,000 ppm concentration of KNO$_3$ (Figure 3). All the other concentrations of KNO$_3$ were statistically at par with one another in terms of G percentage while a 30,000 ppm concentration was higher in GE than 10,000, 20,000, and 25,000 ppm concentrations of KNO$_3$. All KNO$_3$ concentrations showed a significantly higher G percentage and GE than the distilled water treated and non-soaked seeds, whereas distilled water treated seeds showed a higher G percentage than non-soaked seeds. *Astragalus* spp. behavior (Figure 4) toward KNO$_3$ concentrations was not as responsive in breaking dormancy as distilled water but the lowest concentration (5,000 ppm) was statistically at par with distilled water treated seeds and showed almost double G percentage than non-soaked seeds of *Astragalus* spp. G percentage and GE of *Astragalus* spp. declined with increase in concentrations of KNO$_3$ up to 25,000 ppm but a little bit higher at 30,000 ppm which was statistically similar with that of the 20,000 ppm KNO$_3$ concentration.

Similar results were observed by Ramzan et al. (2010) who stated that among the KNO$_3$ concentrations (10,000, 20,000, 30,000, 40,000 and 50,000 ppm) lower concentrations (10000 and 20,000 ppm) and distilled water were more effective than that of higher concentrations when tested against *Allium sativum* seeds. Nitrogen containing compounds like KNO$_3$, NaNO$_3$, NHNO$_3$ and NH$_4$Cl enhanced the seed germination of *Centaurea tomentella*, *Chenopodium album* and other plants (Uysal
Dormancy studies on *Euphorbia dracunculoides* and *Astragalus* spp. ...

**Figure 3** - Effect of KNO₃ on the seed germination percentage and germination energy of *E. dracunculoides*.

NS = not soaked, DW = distilled water.

**Figure 4** - Effect of KNO₃ on the seed germination percentage and germination energy of *Astragalus* spp.

NS = not soaked, DW = distilled water.

An increase in the Thiourea concentration statistically increased the G percentage of *E. dracunculoides* compared to distilled water treated and non-soaked (control) seeds and maximum (51%) G was observed at 250 ppm, whereas GE was maximum (25.50) at 300 ppm Thiourea, which was statistically at par with 100, 150 and 250 ppm (Figures 5 and 6). *Astragalus* spp., showed maximum G percentage and GE (28, 18, respectively) at 150 ppm Thiourea which were statistically similar to those of distilled water (27, 17, respectively). Thiourea concentrations up to 200 ppm increased the seed G percentage of
Astragalus spp. compared to non-soaked seeds. Astragalus spp. showed significantly less G percentage at the highest concentrations of Thiourea (250 and 300 ppm) than the non-soaked seeds. Astragalus spp. showed higher G energy at all the concentrations of Thiourea except 300 ppm compared to non-soaked seeds.

Khan et al. (2003) reported that G of A. prostrata was stimulated by Thiourea and nitrate compounds. In another study, Erez (2005) stated that Thiourea promoted growth in soybean, tobacco, and apple. Ali et al. (2011) revealed contradictory results, as Thiourea and KNO₃ were ineffective in breaking seed dormancy of Rhynochosia capitata.

In conclusion, these results suggest that GA₃ and KNO₃ were the most and Thiourea was the less effective in breaking the seed dormancy of E. dracunculoides, while in Astragalus spp. all three chemicals were not very effective but gave a little bit higher germination compared to control (non-soaked).

NS = not soaked, DW = distilled water.

Figure 5 - Effect of Thiourea on the seed germination percentage of E. dracunculoides and Astragalus spp.

Figure 6 - Effect of Thiourea on the germination energy of E. dracunculoides and Astragalus spp.
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LITERATURE CITED


