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Ecological and Phytochemical Studies on *Solenostemma argel* Growing in Saudi Arabia

1 – Germination of the Seeds Under Different Conditions

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Solenostemma argel (Del.) Hyane seeds were tested for germination under different conditions. The treatment of seeds with conc. H_2SO_4 or dilute H_2SO_4 (50%) did not improve germination. The seeds are very sensitive to salinity since no germination was obtained under 0.4 & 0.3 M saline solutions and did not exceed 10% under 0.2 and 0.1 M saline solutions and the plant normaly grows in desert areas characterized by low salt content.

With regard to the effect of depth of sowing on germination, it was found that the suitable depth for sowing was the upper surface layer.

The seeds failed to germinate with 5 and 10mm equivalents of rainfall but started to germinate under higher levels of rainfall equivalents.

The studied seeds showed higher capacity to germinate under the alternating temperature of 10-25 °C where the maximum percentage was obtained. It can germinate also at constant temperatures of 25°C and 35°C and at the alternating temperature of 25-35°C.

Germination of seeds under natural conditions is more pronounced in the germination bed which is the uppermost soil layer, showing the widest seasonal and daily fluctuations of temperature. It is subjected to high soil moisture tension and sometimes to high salt content. Therefore it is of interest to study the effect of various factors on the germination of this medicinal plant, and the optimal conditions required for establishing good stand of this species.

In the present study, attention has been directed to the effect of acid treatment, salinity, depth of sowing, rainfall and temperature on germination of seeds of *Solenostemma argel*.

Material and Methods

Seeds of *Solenostemma argel* (Del.) Hayne, family Asclepiadaceae (Migahid, 1978) were collected from El-Shafa area situated 24 km far from El-Taif, on lst. of January 1980. The fully mature seeds were cleaned and stored until time of investigation.

The object of the present study is to carry out some investigations on problems of germination.

Germination was tested on 12/1/1980 in Petri-dishes 9 cm diameter, containing filter paper moistened with distilled water or the test solution. Five replicates were used for each treatment and 20 seeds were placed in each dish. Observations were made every 24 hours. A seed was considered to be germinated when the protruding root tip was visible.

Effect of Sulphuric Acid

The seeds were treated with the following acids:

A) With conc. sulphuric acid (98%) for 0, 10, 20, 30 and 40 minutes in small beakers, then rapidly washed with distilled water until free from the acid.

B) With dilute sulphuric acid (50%) for 0, 30, 60 and 90 minutes.

The washed treated seeds were then germinated at a constant temperature of 25°C. The experiment was conducted during the period starting from the 9*th* of January until its end.

Effect of Salinity

Germination was carried out in Petri-dishes containing a layer of pure washed sand, as a culture medium of one cm thickness. Replicates of four concentrations of Na Cl solution, namely, 0. 2, 0.3 and 0.4 M were used. 20 seeds were placed in each dish and then watered with the respective solution until the soil reached approximately the field capacity. Germination was carried out at 25°C.

Effect of Sowing Depth

The seeds were sown at depths of 1/2, 1,2,4 and 6 cm and were irrigated with water to keep the soil nearly around the field capacity. Emergent seedlings were daily counted and recorded.

Effect of Rainfall

Germination was conducted in containers filled with sand. Five sets of containers were used. The seeds were sown in each container near the surface. In the first set, the containers were irrigated with water equivalent to 5 mm rainfall. In the other sets, the amounts of water used were equivalent to 10, 15, 20 and 30 mm rainfall, respectively. The experiment was carried out at 25°C.

Effect of Temperature

Germination experiments were conducted under:

a) Constant temperatures of 25 and 35°C.

b) Alternating temperatures of 10-25°C and 25-35°C.

Results

The average number of seeds per fruit was 68 seeds. The seed had an average weight of 6.0 mg. The length varied from 0.4 to 0.56 mm and the breadth from 0.16 to 0.24 mm. The shape index, expressed as lenght/breadth ratio varied from 2.5 to 2.3

Effect of Sulphuric Acid

a) *Treatment with conc.* $H_2 SO_4$

The percentage of germination did not increase by more than 40% when the seeds were soaked for 10 minutes. Longer durations of soaking in acid were associated with destruction of seeds (Fig. 1-A).

b) *Treatment with 50%* $H_2 SO_4$

Soaking the seeds for periods of 30,60 and 90 minutes was detrimental.

Effect of Salinity

The seeds of *Solenostemma argel* were very sensitive to salinity during their germination period. They failed to germinate in the saline solutions of NaCl with concentrations of 0.4 and 0.3 M, but in lower concentrations of 0.2 and 0.1 M the percentage of germination did not increase more than 10%.

Effect of Depth of Sowing

Seeds sown superficially, at depths not exceeding 2 cm, showed a higher percentage of germination, and the percentage of emerged seedlings greathy diminshed with depth (Fig. 1-B)

Effect of Rainfall

It is evident that the rainfall plays an important role in determining the germination percentage of desert plants. *Solenostemma* seeds failed to germinate at 5 & 10 mm levels, but the percentage of seelding emergence could be achieved by adding 5 more mm equivalent of rain to each container 7 days after the 1st shower.

Generally, the higher the rainfall equivalent, up to 15 mm, the earlier the germination and the higher would be its percentage (Fig. 1-C). At a rainfall of 30 mm, the seed germination was delayed and its percentage decreased to 30%.

Effect of Temperature

a) *Constant Temperatures*

At a constant temperature of 35°C the seeds started to germinate after 9 days and the germination percentage did not exceed 70% after 21 days. But at a constant temperature of 25°C the percentage reached 50% in four days and 100% in 17 days (Fig 1-D)

b) *Alternating Temperatures*

It is evident that the alternating temperatures were very effective. The maximum germination percentage occurred at the alternating temperatures of 10-25°C, being 100% after 10 days. At alternating temperatures of 25-35°C it did not exceed 80% in 14 days (Fig.1-D).

Discussion

It is known that seeds of desert plants are subjected to severe conditions during germination.

A review of literature concerning the improvement of germination by treatment of seeds with sulphuric acid (Kooler and Negbi 1959, Abd El-Rahman & El-Monayeri 1967 a, and Shalaby *et al.*1972) shows that the improvement may be due to structures enclosing the embryo or to the removal of chemical inhibitors which retard germination. These findings have a great value from the economic point since they result in increased germination. Accordingly the seeds of *Solenostemma argel* were subjected to treatment with acids, but the results obtained indicated that the seeds were able to germinate under desert conditions without acid treatments.

In the present study, it is shown that the seeds are very sensitive to salinity during germination. In nature *Solenostemma argel* inhabits areas characterised by low salt content, and disappeared completely in even slightly saline areas.

The germination of seeds diminished as the sowing depth in the soil was increased. The highest percentage is achieved in the upper two centimeters of the soil, where most seeds are likely to be present in nature (Hammouda & Shalaby 1957, Shalaby *et al.* 1972, Shalaby & Youssef 1967, Abd El-Rahman and El-Monayeri 1967 b).

The seeds failed to germinate at the levels of 5 and 10 mm rainfall. This may be due to decreased soil moisture availability, or due to delayed hydration of seeds (Abd El-Rahman & El-Monayeri 1967 and Batanony & Zieghler 1971). Generally, with the increase in level of rainfall up to 15 mm emergence started earlier and the germination percentage increased.

The seeds are able to germinate most successfully under the alternating temperatures of 10-25°C. This range represents a specific thermal adaptation to the prevailing temperature conditions in the field, accordingly the seeds were found to be able to germinate to a percentage of 100%. The seeds can also germinate earlier at 25°C and at the alternating temperatures of 25-35°C.

Several workers have shown that germination is markedly favoured by alternating temperatures (Hammouda & Shalaby 1957, Abd El-Rahman and El-Monayeri 1967 b and Shalaby *et al.* 1972).

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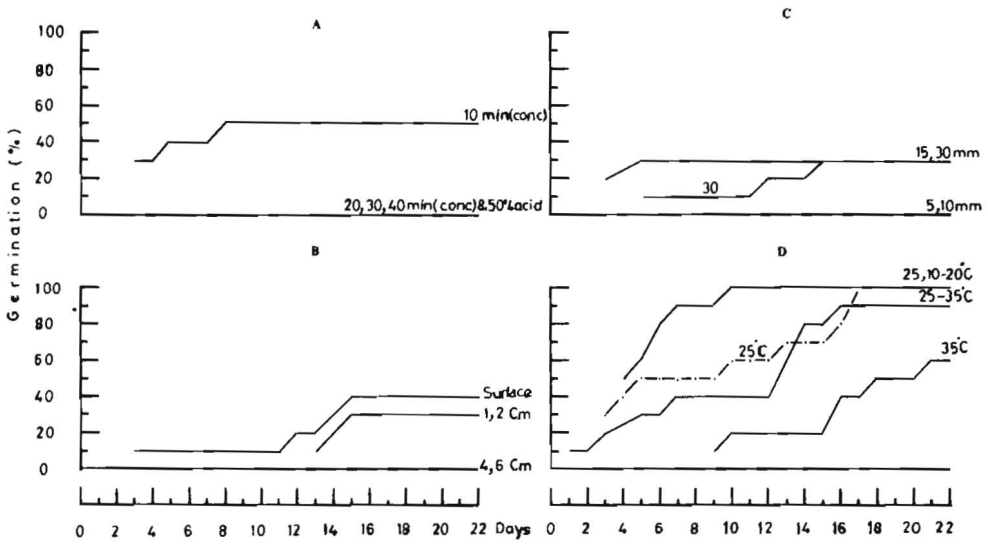

Fig.1. Germination of seeds of *Solenostemma argel* (A) at different treatments of concentrated and 50% sulphuric acid, (B) at different sowing depths (C) at different levels of rainfall, and (D) at different temperatures.

دراسات بيئية وفيتوكميائية على نبات الحرجل النامي بالمملكة العربية السعودية

١ - دراسة انبات البذور تحت ظروف مختلفة

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تمت دراسة أنسب الظروف الملائمة لإنبات بذور نبات الحرجل حيث عرضت بذور النبات لنقع في حامض كبريتيك مركز ومخفف (٥٠٪) ولظروف مختلفة من درجات الحرارة وكمية المطر وتركيز الملوحة والعمق.

وتتلخص النتائج في الآتي:

أولاً: عولجت بذور النبات بحامض كبريتيك درجة تركيز ٩٨٪، ٥٠٪ لإمكانية زيادة نسبة الانبات.

ثانياً: لم تتحمل البذور ان تنبت في تركيز أكثر من ٢ر٠ ع من محلول كلوريد الصوديوم

ثالثاً: وجد أن أنسب عمق لزراعة البذور هو في حدود ٢ سم من سطح التربة.

رابعاً: إن البذور ليس لها القدرة على الانبات فيما يعادل ٥ ، ١٠ ملليمتر من المطر. ولكن ازدادت نسبة الانبات بزيادة كمية المطر.

خامساً: إن البذور لها القدرة على الانبات في مدى من درجات الحرارة تتراوح بين ١٠ ، ٣٥ْ م، وكانت أعلى نسبة لانبات البذور (١٠٠٪) وفي أقل مدة ممكنة هي درجة الحرارة المتغيرة ما بين ١٠ - ٢٥ْ م وكذلك درجة ٢٥ْ م، أما درجة الحرارة المتغيرة ما بين ٢٥ - ٣٥ْ م فوصلت فيها نسبة الانبات الى ٨٠٪ في مدة ١٤ يوماً، وفي درجة حرارة ٣٥ْ م وصلت نسبة الانبات الى ٧٠٪ في ٢١ يوماً.