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Effect of magnesium sulphate on the first stage of development of Lucerne

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SUMMARY – In the south of Tunisia, the water used in irrigation, especially geothermic water, is rich in sulphates. The objective of this study was to evaluate the effect of increasing concentrations of magnesium sulphate ($MgSO_4$) from 0 to 5 g/l on the development of alfalfa (*Medicago sativa* L.) during its first stages of growth. Results showed that: (i) a high level of germination (>90%) was detected even at high concentrations, however, a concentration of 5 g/l of $MgSO_4$ produced a delay in the germination stage of 36 hours; and (ii) high concentrations resulted in decreased production (88% for a concentration of 5 g/l).

Key words: Germination, growth, alfalfa, production, sulphate.

RESUME – *"Effet du sulfate de magnésium sur le premier stade de développement de la luzerne". Dans le sud tunisien, les eaux d'irrigation, notamment les eaux géothermales, sont riches en sulfates. L'objectif de cette étude est d'évaluer le comportement de la luzerne (*Medicago sativa *L.), aux stades jeunes, vis-à-vis de concentrations croissantes de sulfate de magnésium (0 à 5 g.l^{-1}). Les résultats ont montré : (i) de forts pourcentages de germination (> à 90 %) ont été détectés même en présence de fortes concentrations de $MgSO_4$. Cependant, la concentration 5g.l^{-1} de $MgSO_4$ a entraîné un retard de germination de 36 heures ; et (ii) les fortes concentrations ont induit une réduction de la production (88% pour la concentration 5 g.l^{-1}).*

Mots-clés : *Germination, croissance, luzerne, production, sulfate.*

Introduction

In the south of Tunisia and particularly in the oasis conditions, extension of salinity and scarcity of water are the most important problems. Choice of resistant plants to these conditions is very necessary. Lucerne (*Medicago sativa* L.) or alfalfa, is known to be resistant to salinity and represent an important potential for fodder production. NaCl is the most applied salt in studying germination. Studies showed that the percentage of wheat germination reduces until 3 g l^{-1} of NaCl (Bizid and Zid, 1986) and the effect of NaCl results in a delay of the germination speed (Belkhodja and Soltani, 1992). However, others salts as well as sulphate may play a significant role in affecting plants development.

The aim of this work is to study the effect of magnesium sulphate on the first stadium of development of Lucerne cultivated in the oasis conditions.

Materials and methods

To study the effect of $MgSO_4$ on Lucerne germination, 50 seeds of Lucerne were placed in Petri dishes which were sealed with water soaked cotton. To determine the effect of $MgSO_4$, five concentrations were used: 0; 2; 3; 4 and 5 g l^{-1}. Three replications were used for each treatment; the germinative capacity was calculated using the following index:

%PG=GG/TN*100, where: GG= number of germinated seeds, TN=total number of seeds.

A second experiment was conducted in plastic pots with 5 litres volume each to study the effect of $MgSO_4$ on Lucerne growth. In each pot, 20 seeds were grown with three replications.

Plants were irrigated with the same quantity of water in order to maintain field capacity and to restore the water loosed by evapotranspiration. Five concentrations were applied C1: 2 g l^{-1}; C2: 3 g l^{-1}; C3: 4 g l^{-1}; C4 :5 g l^{-1}, the water practised in irrigation in the oasis (1g l^{-1} of $MgSO_4$) was chosen as a control treatment (T).

In addition of weekly measures of plants length from the basis to apex, four cuts were realised; after 60, 90, 120 and 150 days. Five plants by treatment are used to measure: fresh and dry matter for leaves and stems.

Results and discussion

Influence of magnesium sulphate on Lucerne germination

Germination is a crucial stage in the development of alfalfa. Percentages of germination are illustrated by Fig. 1. Seeds of lucerne showed raised rates (>90%) even for strong concentrations in $MgSO_4$, however, the effect of the magnesium sulphate especially results in a delay of germination for the concentration 5 g l^{-1} that reduces the germination percentage to 50% for the first day compared to T treatment.

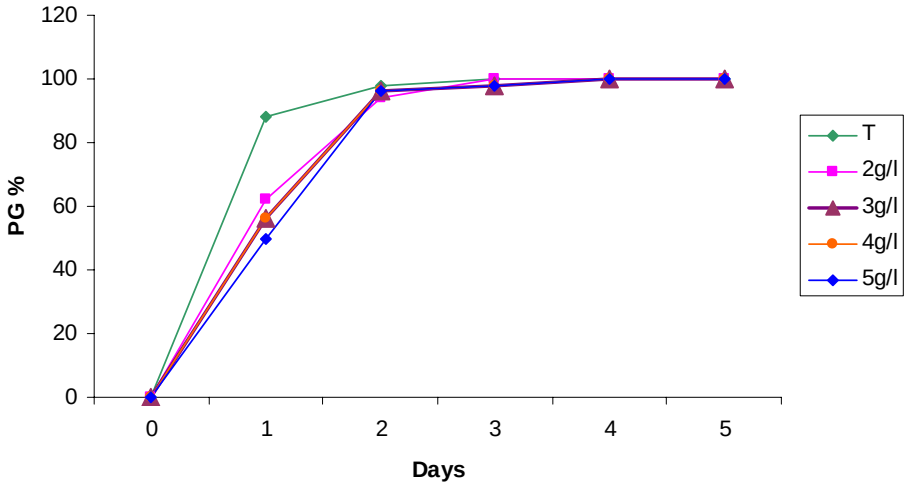
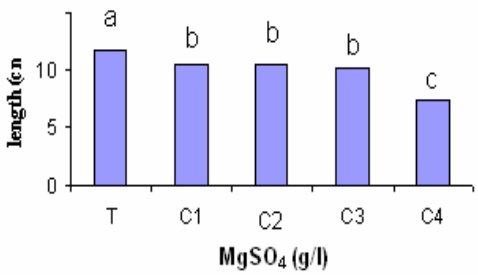


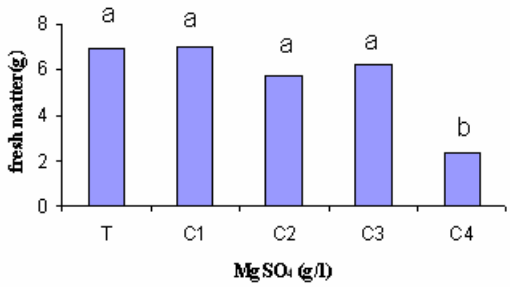
Fig. 1. Effect of $MgSO_4$ on % of germination.

Influence of magnesium sulphate on lucerne growth

Length and fresh matter

The growth on length and fresh matter for the mean of cuts are carried on Fig. 2 and Fig. 3. Our results showed that growth is very sensible to $MgSO_4$. This reduction becomes more pronounced for the concentration 5 g l^{-1} that has the most depressive effect, whereas, the control treatment, offers the highest length oh alfalfa. These results are in agreement with results of (Ben Younes *et al*., 1999) that showed that the length of alfalfa is reduced by salinity of the soil and the water. Statistically, the Duncan test revealed significant differences ($p<0.001$), 3 groups were distinguish for which the length varies from 11.6 cm for the control treatment, 10.5 cm for C1, C2, C3 and 7.4 cm for C4 treatment. The variation of fresh matter produced is illustrated by the Fig. 3. The increasing concentrations of $MgSO_4$ induced a decrease in fresh matter production (Fig. 3). Duncan test showed that fresh matter decreased mainly at the concentration 5 g l^{-1}. Many studies revealed that the effect of NaCl results in a reduction in the fresh matter until the third week of culture from 6 g l^{-1} of NaCl (Boughanmi, 1999). Results of Fathalli and Bizid (1986) showed that for *Medicago ciliaris*, NaCl doesn't modify the fresh biomass until 7 g l^{1} whereas results of Mezni *et al*., (1999) indicate that biomass production of alfalfa (The gabesian cultivar) is affected negatively by the increasing of salinity.





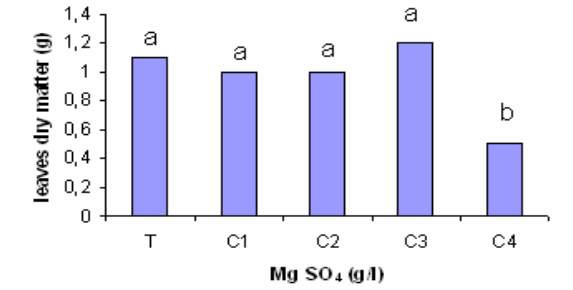
Values with the same letter do not statistically differ to the doorstep of 1% by the Duncan test.

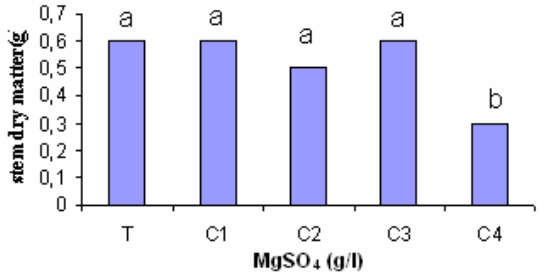
Fig. 2. Effect of $MgSO_4$ on the length (T: control; C1:2 g/l; C2:3 g/l; C3:4 g/l; C4:5 g/l).

Fig. 3. Influence of MgSO4 on fresh matter production.

Influence of magnesium sulphate on leaf and stem dry matter

The Influence of magnesium sulphate on leaf and stem dry matter are illustrated by Fig. 4 and Fig. 5. It shows that in plants exposed to 5g l^{-1}, a significant reduction in dry matter of leaf was observed as compared to others treatments. The stem dry matter variation under different concentrations of $MgSO_4$ is presented by the Fig. 5. The 5g l^{-1} $MgSO_4$ treated plants indicates a decrease in dry matter of stem for the mean of cuts. Others works showed that salinity exercises a depressive effect on the dry matter in the aerial part of barley (Eleuch *et al*., 2004). It is in agreement with our results that revealed a strong reduction of leaves and steams dry matter under $MgSO_4$.





Values with the same letter do not statistically differ to the doorstep of 1% by the Duncan test.

Fig. 4. Influence of $MgSO_4$ on leaves dry matter production.

Fig. 5. Influence of $MgSO_4$ on stem dry matter production.

Conclusion

Thus it is clear that, in Mediterranean environments plants are able to acclimate to stress. This study revealed the capacity of Lucerne to survive under stress conditions. This adaptation may lead to the persistence of Lucerne cultivated in the oasis of Gabès known by its tolerance to salinity.

Our results points out the importance of Lucerne as fodder plant, which has good physiological potentials throughout its parts under stress. Further investigations of biochemical and genetic potentials are required to ascertain this conclusion.

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