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Effect of Salinity and Plant Growth Regulators on Seed Germination of *Medicago sativa* L.

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Abstract

Plant growth regulators, ethrel, kinetin and GA₃, either alone or in combination stimulated the germination of *Medicago sativa* L. seeds. NaCl reduced germination at all concentrations used and its stress on germination, was alleviated by these growth regulators, when applied alone or in combination.

Introduction

Application of ethylene, GA₃, IAA or kinetin alone or in combination, have been reported to induce seed germination of various plant species (Igbinosa and Okonkwo 1992; Sanchez-Calle, 1989; Sinska, 1989). In other investigations, no promotive effect on germination has been shown by kinetin and/or ethylene (Li and Fei, 1992; Zarnstorff *et al.*, 1994; Lalonde and Saini, 1992). In *Medicago sativa*, *Trifolium brachycalycium*, lettuce and others, seed germination was reduced with increase in NaCl concentration (Aparacio *et al.*, 1981; Scorer, *et al.*, 1985; Khan and Rizvi, 1994). Plant growth regulators are effective in preventing or reducing the adverse effects of salinity on germination (Braun and Khan, 1976; Bozcuk, 1981; Khan arid Rizvi, 1994; Khan and Ungar, 1997).

The present study was under taken to see the effect of some growth regulators and salt stress on seed germination of *Medicago sativa*, an important fodder crop. grown, widely, in Saudi Arabia.

Materials and Methods

Seeds of *Medicago sativa*, collected locally, were surface sterilized, blot dried and germinated in 9 cm petri plates, each containing two Whatman No. 1 filter papers and 5 ml of relevant test solution/mixture of solutions or distilled water. 10 seeds were transferred in each plate and replicated four times. Plates were sealed with parafilm and incubated at 25 ± 1°C in dark. The extent of germination was recorded after 5 days of incubation.

Concentrations of the test solution were as follows:

Ethrel: 100, 250, 500 750, 1000 mg/L.

Kinetin and GA₃: each 10, 25, 50, 75, 100 mg/L.

NaCl: 0.001, 0.01, 0.1 and 1.0, M.

For combination of hormones plus NaCl, the following concentrations were used.

Ethrel, 250 mg/L; kinetin 10 mg/L.

GA, 50 mg/L; NaCl 0.1M.

Results

Seed germination of *Medicago sativa* increased with increased concentration of ethrel and maximum germination

was observed in 250 mg/L, and decreased at higher concentration. Kinetin and GA₃ also showed promotive effect on germination but not as significant as with ethrel (Table 1). Combination of the growth regulators used, did not show any promotive effect as compared to the results when used alone (Table, 2). However, all these combination showed higher germination than control.

With mild salinity (0.001 M, NaCl) the germination increased over control but at higher concentrations, the germination decreased and 100 percent inhibition was observed at 1.0 M NaCl (Table 3).

These hormones, when applied with NaCl individually, increased the germination considerably as compared to the germination in NaCl alone. With different combinations of these hormone plus NaCl, the germination further increased. Ethrel, in combination with other hormones proved to be the best to reduce the adverse effect of salinity on germination (Table 4).

Discussion

Results of the present study revealed that the application of ethrel (an ethylene releasing compound), kinetin and GA₃ promoted seed germination of *Medicago sativa*. These results are in close agreement with the previous findings where ethylene or ethylene releasing compounds stimulated seed germination (Esashi and Leopold, 1969; Lalonde and Saini, 1992). Kinetin and GA₃ have also been reported to stimulate seed germination of various species via enhancement of endogenous ethylene production. (Babiker *et al.*, 1993; Igbinosa and Okonkwo, 1992). However, in present studies GA₃ and kinetin promoted germination slightly which may be similar to those species which did not respond to kinetin and GA₃ (Saini *et al.*, 1986, Lalonde and Saini, 1992; Zarnstorff *et al.*, 1994). Additive effect of hormone on seed germination has been reported (Sinska, 1989; Tao *et al.*, 1974). In the present study no additive effect of hormones is observed, with slight increase over control.

Salinity affected adversely the germination of *Medicago sativa* and adverse effect salinity was reduced by application of hormones. These findings are in close agreement with previous studies on *M. sativa* and *Trifolium brachycalycinum* and lettuce seed germination under salt stress and its alleviation of additive effects of hormones

Basalah and Muhammad: *Medicago sativa*, plant growth regulators, salinity germination.

Table 1: Effects of different concentrations of ethrel, kinetin and GA₃, on germination of *Medicago sativa* L. seeds.

Treatment	Germination (%)	Treatment	Germination (%)	Treatment	Germination (%)
Ethrel (mg/L)		Kinetin (mg/L)		GA ₃ (mg/L)	
Distilled water	71 ± 2.65	Distilled	71 ± 2.65	Distilled water	71 ± 2.6
100	96 ± 2.12	10	96 ± 3.05	10	90 ± 2.5
250	100 ± 0.00	25	94 ± 2.35	25	93 ± 1.7
500	67 ± 3.53	50	87 ± 1.17	50	97 ± 1.5
750	23 ± 1.53	75	83 ± 1.53	75	90 ± 2.3
1000	10 ± 1.53	100	43 ± 2.53	100	87 ± 2.3

Table 2: Synergistic effect of ethrel, kinetin and GA₃ on germination of *Medicago sativa* L. seeds.

Treatment	Germination (%)
Ethrel + Kinetin	91 ± 2.70
Ethrel + GA ₃	85 ± 2.76
Kinetin + GA ₃	81 ± 1.76
Ethrel + Kinetin + GA ₃	95 ± 1.53

Concentration of ethrel, kinetin and GA₃ on germination of *Medicago sativa* L. seeds.

Table 3: Effect of different concentration of NaCl on germination of *Medicago sativa* L. seeds.

Treatment NaCl (M)	Germination (%)
Distilled water	71.0 ± 2.65
0.001	83.0 ± 1.76
0.01	63.0 ± 1.53
0.1	53.0 ± 2.12
1.0	0.0 ± 0.00

Table 4: Effect of ethrel, kinetin and GA₃, alone or in combinations, plus NaCl, on the germination of *Medicago sativa* L. seeds.

Treatment	Germination (%)
NaCl	53 ± 2.11
Ethrel + NaCl	80 ± 2.50
Kinetin + NaCl	67 ± 1.18
GA ₃ + NaCl	60 ± 2.53
Ethrel + kinetin + NaCl	81 ± 2.53
Kinetin + GA ₃ + NaCl	77 ± 4.12
Ethrel + Kinetin + GA ₃ + NaCl	94 ± 2.12

Concentrations of ethrel, kinetin, GA₃ and NaCl are, 250 mg/L, 50 mg/L and 0.1 M, respectively.

(Braun and Khan, 1976; Aparacio *et al.*, 1981; Khan and Huang, 1988; Khan and Rizvi, 1994; Khan and Ungar, 1997), Kinetin and other hormones may alleviate stress by enhancing ethylene production by ACC oxidase actively and/or synthesis (Khan and Huang, 1988; Igbinnosa and Okonkwo, 1992; Babiker *et al.*, 1993). However, salinity stress seldom acts alone and its effects on germination may be modified by interaction with other environmental parameters (Scorer *et al.*, 1985; Khan and Rizvi, 1994).

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Basalah and Muhammad: *Medicago sativa*, plant growth regulators, salinity germination.

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