S2-006

Chlorophyll Parameters in *Hibiscus sabdariffa and Lupinus albus* Plants in Response To Decreasing Soil Water Potentials and Kinetin Treatments

F.M.Salama , H.M.El-Sharkawi and M.A.A.Gadallah

E-mail:fmsal@aun.eun.eg Botany Department, Faculty of Science, Assiut University, Assiut , Egypt.

Keywords: chlorophyll, salinity, matric potential, kinetin

Introduction

Photosynthesis is reduced by water deficit (Socias *et al.* 1997) and salinity (Salama and Awadalla, 1987) stresses. Salama and Gasanav (1977) reported the suppression of oxygen evolutin rate from wheat leaves by increasing salinity and water deficiency in plant tissues favour chlorophyll aggregation. 1968). Kinetin, preserve chlorophyll integrity agents degradation by either heat or stress (Gadallah and El-Enany, 1999). the present investigation aimed to study the interactive effects between soil water stress, both matric (Ψ_m) and osmotic (Ψ_s) stresses, and kinetin treatment (exogenously applied in different concentrations) on chlorophyll (a) and chlorophyll (b) contents, (chl. a / chl. b) ratio and stability of chlorophyll to heat in *Hibiscus sabdariffa* L. and *Lupinus albus* L. plants.

Materials and Methods

Rama (*Hibiscus sabdariffa* L.) and lupin (*Lupinus albus* L. = *Lupinus termis* Forssk.) plants were grown in plastic pots containing 1400 g. air dry soil (sand / clay 2:1 v/v) under natural conditions. The plants in each pot were watered with 150 ml of full strength Hoagland nutrient solution (Hoagland and Arnon, 1950). Five plants were allowed to grow in each pot. Treatment of plants with saline solutions began when seedlings were 7 weeks old . Ψ_s levels were chosen at 0 (control), -3, -7 ,-10 and –13 bar. soil water matrix potential levels (Ψ_m) were chosen at : -0.3, -3, -7, -10, and –13 bar. The kinetin concentrations (5, 15 and 30 ppm = K_1, K_2 and K_3 respectively) were applied by spraying the shoot system . Three replicates (planted pots) were assigned at random for each treatment. Chlorophyll content (a and b) was determined according to Todd and Basler (1965). Chlorophyll stability to heat was assessed according to the method of Murty and Majumder (1962), and the chlorophyll stability index (CSI) was modified as the percentage of chlorophyll content of the heated sample relative to its content in the fresh sample.

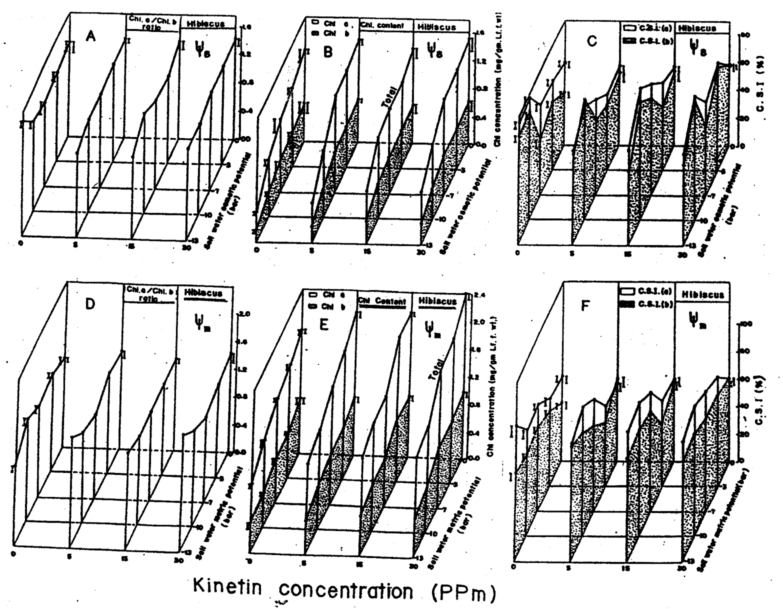
Results

I- Interactive effects of kinetin with osmotic water potential (Ψ_s) :

(a)Chlorophyll content : In the absence of kinetin (K_0), there was a progressive significant decreasing trend in Chl.a and Chl.b in *H. sabdariffa* with increasing osmotic stress (Fig. 1). Kinetin treatment increased significantly Chl.a content in both unstressed and stressed plants with few exceptions. Chl.b significantly increased by kinetin only at higher stress levels. In *L. albus,* a similar progressive significant decreasing effect of osmotic stress on Chlorophyll content was noticed (Fig. 2). Kinetin, generally, caused highly significant increases in Chl.a and Chl.b contents in both unstressed and stressed plants.

(b) Chl.a/Chl.b ratio: In the absence of kinetin, there were non-significant changes in Chl.a/Chl.b ratio in *H. sabdariffa* plants with decreasing Ψ_s (Fig. 1). In the presence of kinetin, the effects of stress were diversed according to the kinetin concentrations and stress level. In *L. albus* (Fig .2) imposing salt stress significantly decreased Chl.a/Chl.b ratio at –3 bar. The effect of osmotic stress was variable according to kinetin concentration.

Fig.1: Changes in chlorophyll content, Chl.a/Chl.b ratio and Chl. Stability to heat in *Hibiscus sabdariffa* plants at different $\Psi_{s,}$ Ψ_m levels and kinetin concentrations.

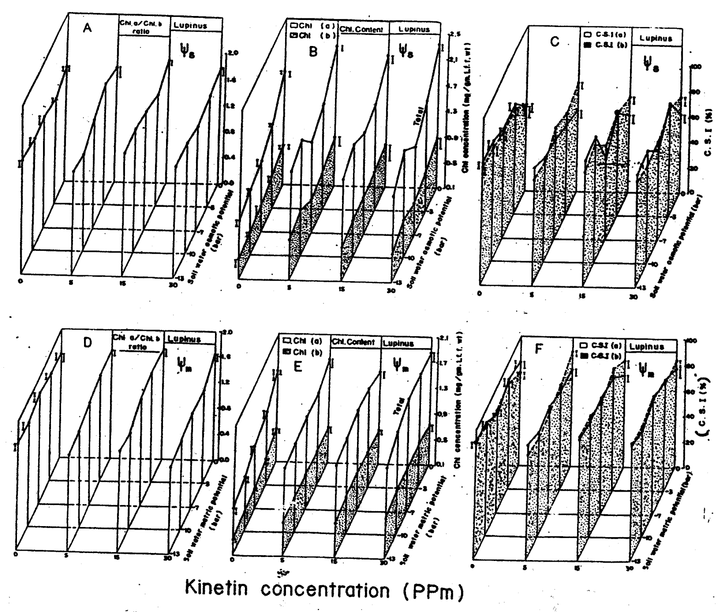


(c) Chlorophyll stability to heat : In *H. sabdareffa* (Fig. 1), Chl.a and Chl.b stability to heat increased significantly with decreasing Ψ_s except Chl.b at –7 bar. Kinetin generally caused significant increase in stability of Chl.a except at unstressed plants at –13 bar. In *L. albus* (Fig. 2) there is a highly significant increase in chlorophyll stability with increasing Ψ_s . The effects of stress were similar in the presence or absence of kinetin with few exceptions for Chl.b.

II – Interactive effects of kinetin with matric water potential (Ψ_m):

(a) Chlorophyll content: In *H. sabdariffa,* both Chl.a and Chl.b decreased significantly with increasing matric stress (Fig. 1). Kinetin treatment increased significantly chlorophyll content in both unstressed and stressed plants. In *L. albus,* a similar trend of progressive significant decrease in chlorophyll content with decreasing Ψ_m was observed (Fig. 2). Kinetin treatment increased Chl.a and Chl.b contents. The increase was highly significant in general.

Fig.2: Changes in chlorophyll content, Chl.a/Chl.b ratio and Chl. Stability to heat in *Lupinus albus* plants at different Ψ_s, Ψ_m levels and kinetin concentrations.



<u>(b) Chl.a / Chl.b ratio</u> : In the absence of kinetin, Chl.a / Chl.b ratio in *H. sabdariffa* plants (Fig. 1) increased significantly at –3 and –10 bar but significantly decreased at –13 bar. In *L. albus* plants untreated with kinetin, the ratio increased significantly at -7 bar (Fig. 2). Kinetin yielded a different response to increased matric stress.

<u>(c) Chlorophyll stability to heat</u> : In kinetin untreated plants, there was a significant increase in stability of Chl.a and Chl.b in *H. sabdariffa* plants with increasing matric stress (Fig. 1) except at –3 bar for Chl.a. In the presence of kinetin, the significant increase in Chl.a stability is noticed. In *L. albus* (Fig. 2), decreased soil matric potential was accompanied with significant increase in Chl.a stability at –10 and –13 bar. This effect extends in kinetin-treated plants to lower stress levels (-7 bar with K_1 and –3 bar with K_2 and K_3). A tendency of a significant increase in Chl.b stability with decreasing Ψ_m is observed in K_0, K_2 and K_3 plants.

Discussion

The results of this study indicated that in both plants Chl.a and Chl.b contents decreased in response to water stress. This is in agreement with the findings of Salama and Awadallah (1987) and Gadallah and Ramadan (1997). Chlorophyll stability index increased with increasing osmotic or matric stress. The increase varied according to stress type. Kinetin-treated plants have higher Chl.a and Chl.b contents than untreated plants. This has been previously observed by Salama and awadallah (1987) and Gadallah and El-Enany (1999). Such effect could be due to an enhancement of chlorophyll synthesis by kinetin. Apparantly enhancement of chlorophyll synthesis by kinetin was higher at some stress levels than in unstressed plants. The explanation of such response as an outcome of the combined effects : 1-Kinetin increases chlorophyll accumulation and inhibits chlorophyll degradation during water stress (Pilet and Hofer, 1966). 2-Retardation of chloroplast senescence and enhancement of chloroplast replication by kinetin (Rosalinda *et al.* 1971).

3-Stimulation of protochlorophyllide synthesis by kinetin (Bengtson *et al.*, 1977).

Generally, Chl.a / Chl.b ratio was higher in kinetin-treated plants than in unstressed analogues. This may indicate that the production or stimulation of Chl.a synthesis by kinetin was favored that of Chl. b . Sometimes kinetin had different effects on Chl.a / Chl.b ratio at equipotential osmotic and matric stress levels in the same plant (e.g. *H. sabdariffa* at Ψ_s and Ψ_m = -10 to –13 bar) . This may indicate that the effect of kinetin on protochlorophyll formation and preservation of chlorophyll integrity against degradation during stress condition varies according to stress types.

In most cases, kinetin caused increased chlorophyll stability than in kinetin untreated plants probably through decreasing chlorophyll degradation by heat.

References

Bengtson, C. ; B. Klockare ; S. Larsson and S. Christer (1977) : The effect of phytohormones on chlorophyll(ide), protochlorophyll(ide) and carotenoid formation in greening dark grown wheat leaves. *Physiol. Plant.* 40 : 198 – 204.

Gadallah, M.A.A. and A.E.El-Enany (1999) : Role of kinetin in alleviation of copper and zinc toxicity in *Lupinus termis* plants. *Plant Growth Regulation* 29 : 151 – 160.

Gadallh, M A.A. and T. Ramadan (1997) : Effects of zinc and salinity on growth and anatomical structure of *Carthemus tinctorius* L. *Biol. Plant.* 39 : 211 – 218.

Pilet, P. E. and R. M. Hofer (1966) : Action de la kinetin sur la croissance et al teneur en chlorophylles des racines. *Physiol. Plant.* 19 : 1026 – 1037.

Rosalinda, B. ; J.B. James and L. Aeysch (1971) : Induction and regulation of chloroplast replication in mature tobacco leaf tissue. *Plant Physiol.* 47 : 560 – 564.

Salama,F M. and A.A.Awadalla (1987): The effect of different kinetin application methods on some chlorophyll parameters of two crop plants grown under salinity stress. *Phyton*, 27(2) 181 – 193.

Salama,F.M. and R. A. Gasanov (1977): Photosynthesis and formation of the native chlorophyll forms in light harvesting complexes of wheat chloroplasts under physiological drought(salinity). *EZVESTIA, Azerbaijan Academy of Science*, No.6, 28 – 40.

Socias,F.X. ; A. Pol ; F. Aguilo ; J. Vadella and H. Medrauo (1997): Effects of rapidly and gradually induced water stress on plant response in subterranean clover leaves . *J. Plant Physiol*. 150 : 212 – 219.

Todd,G. W. and Basler (1965) : Fate of various protoplasmic constituents in droughted wheat plants. *Phyton* 22 (1) : 79 – 85.