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Effect of Growth Retardants on Nitrate Uptake Kinetics in *Sesamum* Seedlings

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Nitrate (NO_3-) uptake showed biphasic saturation kinetics. First kinetics appeared below 0.25 mM, while second kinetics appeared above 0.25 mM. Growth retardants did not affect NO_3- uptake in first phase while the second phase was considerably inhibited.

Key Words - Biphasic Kinetics Nitrate Retardant Uptake

Despite great biological and agricultural significance, recent reviews on the concentration kinetics of ion transport do not give significant data on NO_3^- uptake kinetics (Nissen, 1974); Epstein, 1976). Although kinetic parameters of NO_3^- uptake have been reviewed (Jackson, 1978; Glass & Siddiqi 1984) no uniform pattern emerges. Phytohormones affect the ion transport in plants (Luttge & Higinbotham 1979). Recent evidences have suggested that NO_3 uptake is regulated by hormones (* Hanisch ten Cate and Breteler, 1982). Plant growth retardants are also reported to affect uptake of some ions (Adedipe, 1975) however, their effects on NO_3^- uptake are not studied by anyone. Therefore in the present work the effect of two growth retardants CCC (2-chloroethyl) trimethylammonium chloride) and B 9 (N, N-dimethylaminosuccinamic acid) on nitrate uptake kinetics in *Sesamum* seedlings during early growth has been studied.

MATERIALS & METHODS Seeds of *Sesamum indicum* L. CV. Gujarat Tel 1 were germinated in dark for 16 h. Fifteen uniformly germinated seeds were transferred to 9 cm Petri dishes containing standard mineral medium (SMM) alone or with growth retardants (100 mg l^{-1}). These seedlings were transferred to continuous light (700 lux maintained by fluorescence tube) and grown up to 48 h. SMM was prepared as described by Doddema *et al* (1978). The culture medium was changed after every 24 h.

NO_3 Uptake Seedlings were thoroughly rinsed with DW and transferred to Petri dishes containing 10 ml different concentrations of KNO_3 (0.02 mM - 2 mM) supplemented with SMM. The uptake of NO3- was stabilized in this solution for 90 min. Seedlings were again transferred to another set of Petri dishes containing the same range of 15 ml KNO_3 solution. In these experiments, seedlings were arranged in such a way that only roots were in contact with the uptake solution. After 5 min, 5 ml solution from each Petri dish was removed and analysed for O h NO_3- uptake. NO_3- uptake was now measured as NO_3- depleted from the ambient solution per hour. NO_3^- in ambient solution was estimated by measuring UV absorption at 210 nm in Beckman 26 Spectrophotometer with quartz cuvettes (Doddema *et al.* 1978). Three replicates were kept for each measurement and the mean uptake is expressed as mole $h^{-1}g^{-1}$ FW roots.

RESULTS & DISCUSSION Concentration kinetics of NO_3- uptake in control and growth retardants treated seedlings are presented in Fig. 1. NO_3^- uptake showed biphasic saturation kinetics in all the treatments. First kinetics appeared around 0.25 mM. The rate of NO_3 uptake again increased above the maximal value of first kinetics indicating a second uptake kinetics. The kinetic parameters K_m and V_{max} for both the phases were determined from the Lineweaver-Burk plot for each treatment and are summarised in Table 1. In all the treatments V_{max} and K_m values were considerably lower for 1st phase as compared to the 2nd phase. These results indicate that No_3^- uptake in lower and higher concentrations is mediated by separate carrier mechanisms.

In 1st phase of NO_3^- uptake, V_{max} and K_m values were similar under all treatments and therefore, growth retardants did not affect NO_3^- uptake in lower concentration. However, at higher concentration V_{max} and K_m values were marginally lower in CCC treatment and significantly reduced under B 9 treatment as compared to control seedlings. Therefore growth retardants affected the 2nd phase of uptake by possibly altering capacity factor as well as intensity factor of carrier.

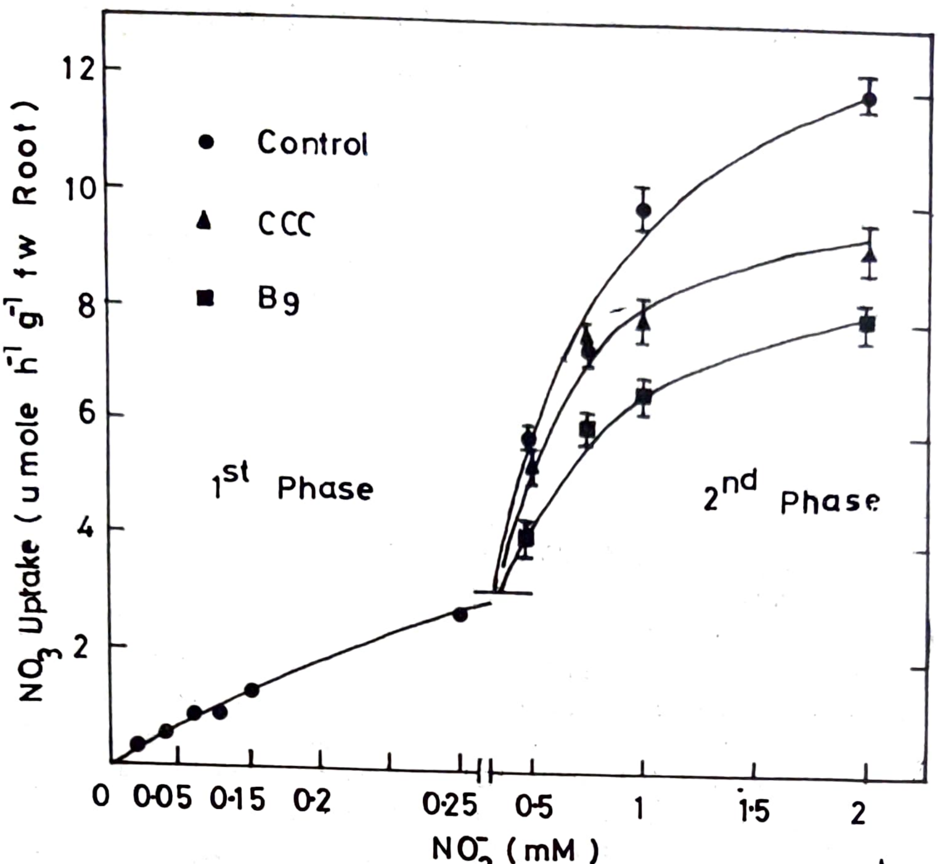

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Fig. 1 Concentration kinetics of nitrate uptake in control and growth retardants (CCC and B 9) treated *Sesamum* seedlings.

Dual phasic kinetic uptake has been observed for large number of non-metabolised ions and it has been suggested that these phases represent transport of ions to different sites (Epstein, 1976). The first phase of uptake, which operates in lower concentration, is believed to represent transport of ions into cytoplasmic metabolic pool and the second phase operating in higher ambient ion concentration represents transport into vacuolar storage pool. Glass & Siddiqi (1984) have suggested that this may be an important aspect of the cell homeostasis. Not much information exists regarding the subcellular localization of NO_3^- ions However, evidences indicate the existence of discrete subcellular pools of these ions (Aslam *et al.* 1976; Martinola *et al.* 1980). The results indicate that as NO_3^- concentration exceeds 0.25 mM, excess nitrate is transported to different site, possibly vacuoles. Growth retardants inhibited NO_3 transport in this phase in different degrees.

Table 1 Kinetic Values of Nitrate Uptake in Control and Growth Retardants Treated Seedlings.

Treatment	Phase I			Phase II		
	V_{max}	K_m	r*	V_{max}	K_m	r*
DW (Control)	3.0	0.19	0.96	15.38	0.86	0.95
CCC	3.2	0.2	0.95	12.12	0.73	0.97
B 9	3.1	0.18	0.95	11.43	0.46	0.95

*, r is coefficient of correlation.

The values were calculated from Lineweaver Burk plots of the data of Fig. 1. Km values are expressed in mM and Vmax values in μ mole h^{-1} g^{-1} FW root.

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