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EFFECT OF POTASSIUM NAPHTHENATE ON AUXIN TRANSPORT IN *ZEA MAYS* L.

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Abstract

Potassium naphthenate affected germination of *Zea mays* seeds more adversely than seedling growth . Coleoptile length was independent of IAA absorption but directly related to its translocation .

Introduction

Naphthenic acid and its salts, particularly potassium naphthenate (K-Nap), have been reported to possess plant growth stimulating properties. The optimum concentration to be applied for an increase in growth ranged from 4% in bean (Popoff & Boikov, 1966) to 40% in cucumber (Husseinov, 1960) . An array of test crops ranging from small plants to big trees have been tried and the use of naphhthenic acid was found to be beneficial for growth and yield with improvement in the quality of product in some cases (Ansari *et al.,* 1978) . Although a number of reports relating to the effect of K-Nap on growth and yield of plants are available in the literature, its influence on auxin physiology at the early developmental stages, has not been explored. This paper reports the effect of K-Nap on auxin transport kinetics in maize coleoptiles.

Materials and Methods

K-Nap was prepared from naphthenic acid (BDH) by neutralizing with KOH and diluting with distilled water (Ansari *et al .,* 1979) . Seeds of *Zea mays* L. soaked in distilled water (control) and in 0.001, 0.01, 0.05, 0.10 and 0.50% K-Nap solution for 2 h, were planted over a cotton pad, moistened with distilled water. In another set, the coleoptile segments from the control were used and 0.01% K-Nap was incorporated into the donor agar blocks. In both cases seedlings were raised for 96 h in complete darkness.

Auxin transport determinations, from both the sets, were made by the standard donor : tissue: receiver system using 10 mm coleoptile segments excised 1-2mm below the tip (Naqvi *et al .,* 1983). A 2 h transport determination was made with coleoptile segments obtained from the first set of experiments and the kinetics of the transport was worked

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out in the second set of experiments. ^{14}C-IAA (sp. act. 2 GBq/mM, Amersham) was incorporated into donor blocks at a concentration of 0.4 mg/l and the receiver block consisted of plain 1.5% agar.

Results and Discussion

K-Nap upto 0.01% showed no effect whereas higher concentrations adversely affected germination of *Zea mays* seeds (Fig.1). K-Nap upto 0.1% concentration increased coleoptile length while it decreased with further increase in the concentration. Seed germination therefore, seems to be more sensitive to K-Nap treatment than coleoptile growth at concentration of 0.05% or lower.

Seeds soaked in K-Nap upto 0.05% also increased the quantity of IAA absorbed and translocated. At 0.1% concentration, auxin transport parameters were unaffected but growth was stimulated, whereas 0.5% reduced growth as well as the IAA translocation without affecting its absorption (Fig.1, Table 1). Coleoptile growth thus seems independent of IAA absorption from the donor but directly related to its translocation below a certain K-Nap level. The total amount of diffusible IAA was not determined but high K-Nap levels presumably influenced the synthesis and/or enhanced the destruction of auxin and thus affecting the auxin translocated.

Using 0.01% K-Nap concentration the auxin transport, measured over a range of time intervals (0.5 to 2 h), showed that there was a gradual increase with time in absorption as well as in translocation of IAA but the depressing effect of K-Nap was again evident (Table 2).

Auxin transport over time was computed as percentage of total counts applied and assayed in donor, tissue and receiver after 0.5, 1.0, 1.5 and 2.0 h and compared with the

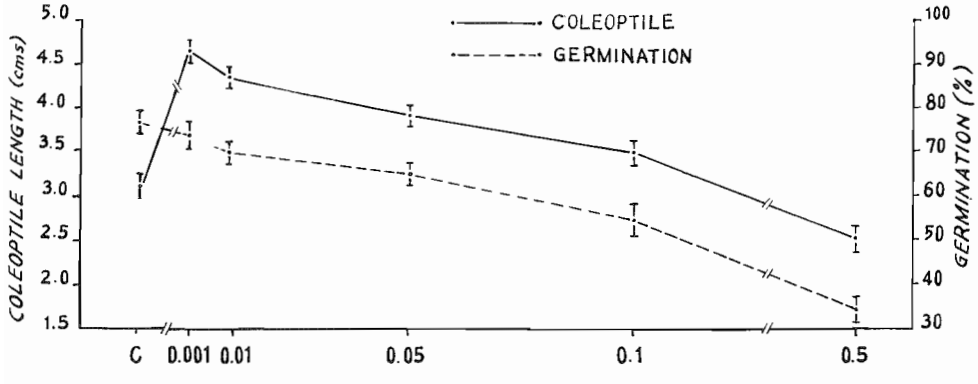

Fig. 1. Effect of soaking with K-Nap on germination and coleoptile length of *Zea mays* L.

Table 1. Effect of K-Nap seed soaking or incorporation in donor blocks on auxin transport in maize coleoptiles.

% IAA	K-Nap (%)					
	0	0.001	0.01	0.05	0.1	0.5
	Seedlings from K-Nap soaked seeds					
Absorbed	33	39	38	39	34	33
Translocated	26	34	31	30	27	20
	K-Nap incorporated in donor blocks					
Absorbed	33	34	23	12	14	10
Translocated	23	26	17	13	13	15

control (Table 3). Although there was a gradual increase with time, lesser percentage of ^{14}C-IAA was being absorbed by the tissue and very small quantities diffused out into the receiver. This lends further support to the conclusion that depression in growth due to high K-Nap levels, also observed in our earlier studies (Ansari *et al.*, 1978), could be attributed in part to a reduction in auxin supply.

Table 2. Effect of 0.01% K-Nap incorporated in agar blocks on auxin transport in maize coleoptiles.

	Transport period (hr)			
	0.5	1.0	1.5	2.0
IAA absorbed (% of applied)				
Control	11	21	24	33
K-Nap	9	13	17	22
^{14}C-IAA translocated (% of absorbed)				
Control	5	16	26	28
K-Nap	3	13	17	22

Table 3. Distribution of ^{14}C-IAA in donor, tissue and receivers calculated as percentage of total.

Counts (% of total)	Control				K-Nap (0.01%)			
	Transport time (hr)							
	0.5	1.0	1.5	2.0	0.5	1.0	1.5	2.0
In donor	88	79	75	67	91	87	83	78
In tissue	10	17	18	24	8	11	14	17
In receiver	2	4	7	19	1	2	3	5

Stresses, including osmotic, ionic, temperature, humidity, have been reported to affect auxin transport parameters (Goldsmith, 1979). Naqvi (1972) observed that salinity did not influence the polarity and the amount of auxin transported through maize coleoptile; but the production of diffusible auxin was reduced under saline conditions (Naqvi & Ansari, 1974). This gets indirect support from work of Derbyshire (1971) who observed increased activity of IAA oxidase in pea and tomato plants which were subjected to water stress by addition of mannitol to nutrient solution. No work on naphthenates on these lines has been reported. Naphthenic acid is however, a complex mixture of several carboxylic acids and to understand properly its biological activity, which may ultimately reflect in growth responses, there is a need to conduct experiments using the component acids as reported recently by El-Wahaishi & Severson (1985).

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