

Appearance of bulges on maize roots as affected by 6-benzylaminopurine and α -naphthylacetic acid

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Abstract

The thickening that appeared on maize roots under the influence of 6-benzylaminopurine and α -naphthylacetic acid (concentration 10^{-5} , 10^{-6} , 10^{-7} and 10^{-8} M) were analysed. The changes in length and width of maize roots at the edge of elongation zone after 24, 48 and 72 h of treatment were studied. The growth in length of cells at the edge of elongation zone stopped abruptly but the growth in width slowly continued. So, the growth of cells in length and width under the influence of growth regulators was not simultaneous. They had distinct time limits.

Additional key words: growth regulators, root length, root width, *Zea mays*.

Introduction

Being affected by different chemical substances with rather high concentration the ends of the plant roots become covered with typical ball-shaped bulges (Zeuding 1955). The question of root bulge origin has been frequently raised in literature. As the growth of the organ is the result of division and elongation of its cells, the problem of how the inhibition of the elongation and the intensification of the cells radial expansion depend on the interruption in the mitotic activity has been constantly in the focus of the discussion (Trojan 1983, Ivanov 1985, De Agazio 1994). This problem was elucidated in experiments with irradiated roots, which had almost inhibited mitosis (Zeuding 1955, Ivanov 1967, 1985). But even on such roots the same bulges as on the non-irradiated roots can appear if they are exposed to the influence of physiologically active substances.

The bulges appear on the edge of the meristem and the elongation zone caused by the shift in growth direction mostly of the meristematic cortex cells, which enter the stage of elongation. The cells start to grow in width and become more isodiametrical. The increase in cell width is accompanied by a decrease in length.

Correlation between the cell growth in length and width are still an open question. Upadhyaya and Nooden (1978) expressed a suggestion that these processes are

autonomous. Svensson (1971) considered the inhibition of the cell elongation and the intensification of radial expansion to be synchronous processes.

In this paper the bulges that appear on maize roots under the influence of synthetical analogues of phytohormones - the 6-benzylaminopurine (BAP) and α -naphthylacetic acid (NAA) - were analysed.

Materials and methods

Maize seeds (*Zea mays* L. cv. Transcarpathian, tooth-shaped) were germinated at 27 °C for two days. Ten sprouts with the root length 25 - 35 mm were planted into pots with 10^{-5} , 10^{-6} , 10^{-7} and 10^{-8} M BAP or NAA and with distilled water (control). After the 24, 48 and 72 h in darkness the roots of each plant were measured with a ruler and the average length was calculated. The experiments were repeated five times.

After 6, 12, 24, 48 and 72 h the cortex cell length and width was measured with the ocular ruler at the longitudinal section of the root at the edge of the elongation zone, exactly at the fourth row of the cortex parenchyma. The length and width of fifty cells taken from three roots were measured.

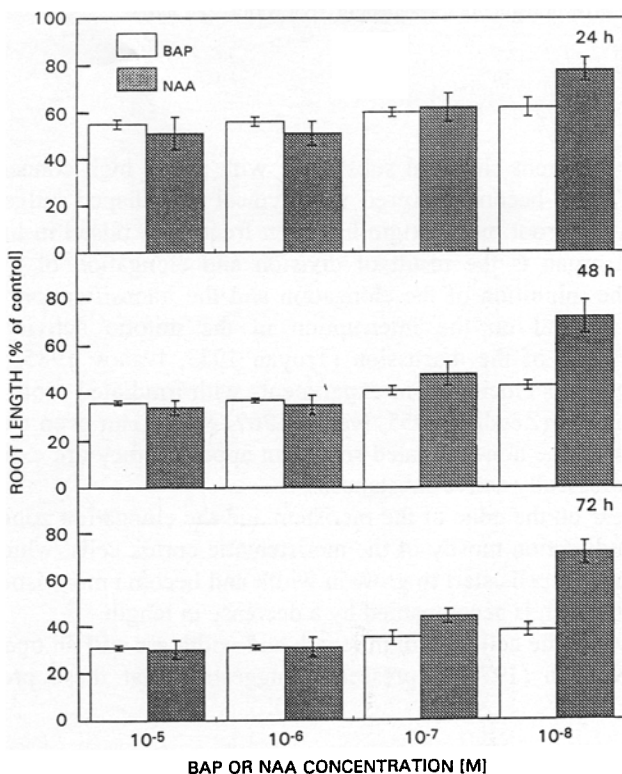


Fig. 1. Maize root length as affected by BAP or NAA at different concentration.

After 72 h the diameters of roots at the edge of elongation zone and in the thickest point of the root were measured. The experiments were repeated three times. The end of the elongation zone was determined by the appearance of root hairs. The usual way to determine the end of the elongation zone in plant roots, according to cells having completed their growth is not appropriate in this case as here we deal with substances that affect the elongation.

Results and discussion

The growth rate of the maize roots was directly affected by BAP or NAA concentration and treatment duration (Fig. 1). The longer BAP and NAA were applied, the stronger the growth of the maize roots was inhibited. The decrease in BAP or NAA concentration pulled down the inhibitory effect, the 10 times decrease in the concentration reduced the inhibitory effect of NAA more strongly than that of BAP.

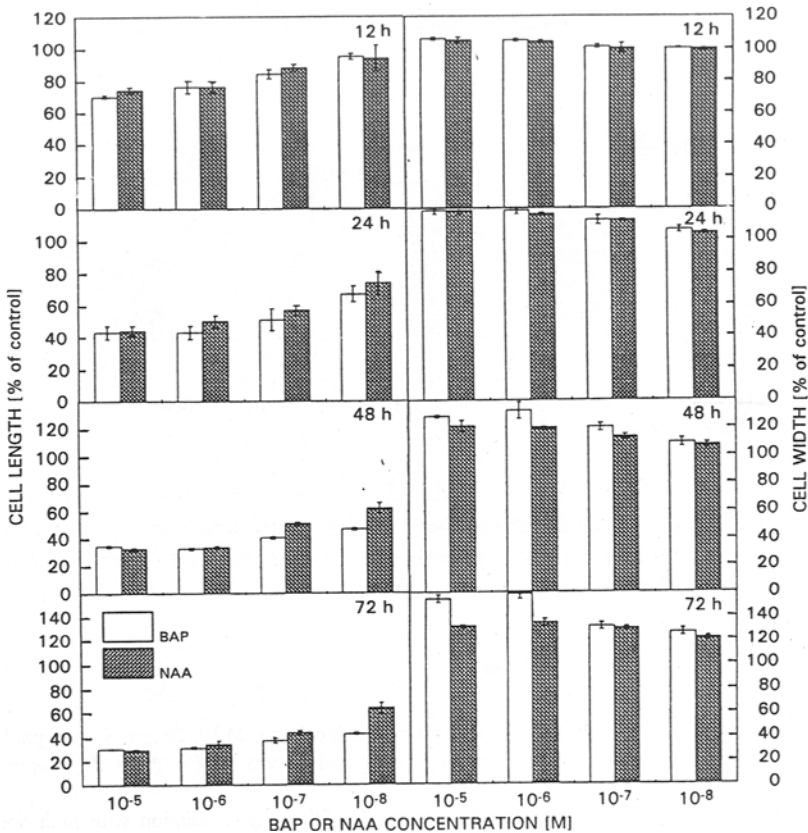


Fig. 2. Length and width of maize root cells at the edge of the elongating zone as affected by BAP or NAA treatment of different duration.

BAP and NAA showed the same trend in affecting maize root growth. After 12 h of treatment a decrease in cell length and an increase in cell width was found (Fig. 2).

The cell measurements on the level of the first root hairs showed that within a certain period of time the growth in length of cells could be abruptly stopped, while the width could be slowly increased. Thus the cell width increased greatly out of the elongation zone. This is proved by the measurement of root diameter at the edge of elongation zone and in the thickest point of maize roots ending (Fig. 3). Thus the growth of cells in length and width did not occur parallelly. They were distinctly separated in time.

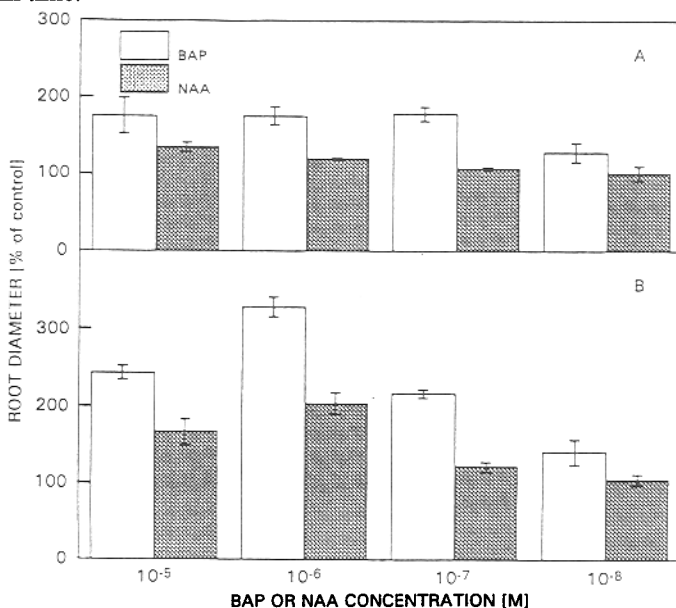


Fig. 3. Maize root diameter at the edge of elongation zone (A) and in the thickest point of root ending (B) as affected by 72-h-treatment with BAP or NAA.

This coincides with the data of Upadhyaya and Nooden (1978) who proved that thickening of isolated longitudinal section of maize roots starts some hours later than slowing of their elongation. Though cells growth in length and width are separated in time, this separation is relative, because the shorter is the cell the wider it is.

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