THE INFLUENCE OF CYTOKININE ON THE NITROGEN DEFICIENCY OF CORN SEEDLINGS

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Abstract. In this study we observed the way in which cytokinine influence the growing of corn seedlings and the conditions in which they present a nitrogen deficiency. We worked with two different concentrations of cytokinine: 1% and respectively 0.1%, introduced into 800 ml of a complete Knop solution, a Knop solution containing a double quantity of nitrogen, compared to the control solution, a Knop solution containing half of the quantity of nitrogen and a Knop solution absent in nitrogen. Daily measurings was made for 14 days, considering the length of the roots and shots, in every experimental variant. This study shows that a direct proportionality exists between the growing rate of the corn seedlings and the nitrogen concentration. It was also showed that the average of the growing rate for a period of 14 days was of 0.28 cm at a nitrogen concentration on 2.0 g/l, and only 0.05 cm in case of nitrogen deficiency. Analyzing the average of the shots growing rate (cm), it was 0.39 in case of the variant with cytokinine 0.1%, 0.45 in case of the variant with cytokinine 1% and 0.36 in case of the control sample.

Keywords: cytokinine**,** nitrogen, measuring, roots, shots, experimental variant.

INTRODUCTION

For their growing and development, plants need - besides the factors of the outside environment (water, nutrient substance, light, oxygen, temperature) – some endogenous substances that are formed in their bodies and influence the biochemical and physiologic processes of growing, named growing substances, phytohormones, growing regulators [2].

Phytohormones are biosynthesized in young cells cytoplasm and accumulate mostly within the growing area of the shots and roots, in sprouts, seeds, pollen, ovaries, young tissues, etc [3].

Phytohormones are organic substances that influence the growing and development processes of seedlings; they operate in vegetal organisms either independently or together with other phytohormones (synergic or antagonic) or associated with other active biologic substances (enzymes, nucleic acids, vitamins, antibiotics) [4].

From chemical point of view, phytohormones are heterogenic micro molecular substances that resemble to vitamins and animal hormones. Their molecules also comprise cyclic rings (inolic, purinic), etheric links and different functional groups. They influence the growth of plants by the intensifying of cellular division or by the elongation of existing cells relative to the nature of phytohormones [7]. Cytokinine can be defined as a substance that in the presence of an optimum concentration of auxin stimulates the cells division in the tissues of tobacco marrow or carrot phloem or soybeans callus [9]. The presence of cytokinine in the wooden food-conducting tissues (xylem) shows that the synthesis of these natural components develops within roots, from which it acropetally migrates to the fruits, leaves and shots once with the perspiration current [1].

MATHERIALS AND METHODS

In this study we observed the way in which cytokinine influence the growing of corn seedlings and the conditions in which they present a nitrogen deficiency.

We worked with two different concentrations of cytokinine: 1% and respectively 0.1%, introduced in 800 ml of a complete Knop solution, a Knop solution containing a double quantity of nitrogen, compared to the control solution, a Knop solution containing half of the quantity of nitrogen and a Knop solution absent in nitrogen.

Under laboratory conditions, the environment in which cytokinine influence the plants was evidenced after repeated measurement, in case of nitrogen deficiency.

The Ariesan variety of corn was used in the experiments, whose caryopses were disinfected by washing with 10% alcohol, and then they were soaked and laid on a wet filter paper.

The formatted seedlings having embryo roots were passed into jars, where different types of the nutritive Knop solutions had been prepared.

Daily measurings were made for 14 days, considering the length of the roots and of the shots, in every experimental variant.

These measurings were made with the ruler, more or less differences being daily recorded. The *t* test was used in order to analyze the obtained results. This test presumes a slightly different distribution relative to the normal distribution, the so called *t* distribution of Student, which shows a slowly leveled normal distribution that leads toward the normal distribution with the increasing of *n* [8].

RESULTS

Table1. The percentage of the roots and shots of the seedlings growing, compared to the control, at different nitrogen concentrations

Variant	Vegetal organs	The percentage of the organs growing compared to the control %			
		Knop solution + Nitrogen 1.0 g/l	Knop solution + Nitrogen 2.0 g/l	Knop solution + Nitrogen 0.5 g/l	Knop solution + Nitrogen 0 g/l
Without adding cytokinine	Roots	100%	203.06%	95.91%	42.44%
	Shots	100%	121.40%	96.96%	82.42%

It can be noted that the highest percentage was recorded for the nutritive environment which contained the highest quantity on nitrogen, respectively 2.0 g/l.

Table 2. The average of the growing rate of the roots and shots of the corn seedlings for a period of 14 days

Variant	Vegetal organs	The percentage of the growing rate (cm)			
		Knop solution + Nitrogen 1.0 g/l	Knop solution + Nitrogen 2.0 g/l	Knop solution + Nitrogen 0.5 g/l	Knop solution + Nitrogen 0 g/l
Without adding cytokinine	Roots	0.14	0.28	0.13	0.05
	Shots	0.44	0.54	0.40	0.36
Cytokinine 1%	Roots	0.65	0.93	0.28	0.20
	Shots	0.51	1.20	0.94	0.45
Cytokinine 0.1%	Roots	0.30	0.44	0.16	0.13
	Shots	0.49	0.65	0.47	0.39

The growing rate of the roots and shots was calculated (cm / 24h); the seedlings had evidently a growing rate proportional with the nitrogen concentration.

The more intense growing of the seedlings which were grown on a nutritive environment that contained the highest quantity of nitrogen can be observed in the Table 2; in this table is presented the average of the growing rate for duration of 14 days.

DISCUSSIONS

A proportionality of the nitrogen concentration that was introduced into the nutritious Knop solution, and the length of the roots of corn seedlings were found from the first day.

The results of the variants were compared in the last day of measuring, to observe the percentage in which the roots of the seedlings had grown, compared to that of the control. Assuming a control of 100%, the obtained percentages are shown in the Table 1.

It could be remarked that the seedlings, at a nitrogen concentration of 2.0 g/l, grew 2.03 times more than the control, while at smaller nitrogen concentrations compared with the control, the increases were insignificant.

The growing rate of the roots was calculated (cm/24h), as the seedlings evidently had a growing rate which is relative to the nitrogen concentration.

More intensive growing of seedlings that were grown on a nutrient environment which contained the highest quantity of nitrogen can be remarked in Table 2.

It can be remarked that the average of the growing rate is 0.28 cm for a nitrogen concentration of 2.0 g/l, and only 0.05 cm in the case of nitrogen absence, for a period of 14 days.

Thus, it can be noted that the nitrogen deficiency induces limitative action on the growing and development of seedlings.

The measuring relative to the average of the corn seedlings shots lengths had been made also for a period of 14 days; in this case it could be remarked also a higher increase of the shots that had grown on a nutritious environment, with a higher nitrogen concentration.

In case of shots, also, as the concentration of nitrogen is higher, the growing is more intense. Thus, it can be found that nitrogen determines an acceleration of growing and an increase of leafy surface, this leading to the growing of photosynthesis.

The measuring obtained in the last day was compared relative to the variants, in order to observe the percentage in which the shots grew, compared to the control, for different nitrogen concentration [see Table 1].

The highest percentage belongs to the highest nitrogen concentration; the nitrogen insufficiency is revealed by slowing or stopping the seedlings growing and by the chlorosis of the leaves.

Comparing the growing rate of the roots and of the shots, for the same nitrogen concentration, it could be remarked that the growing rate of the shots is much higher than that of the roots.

Thus, in case of the shots that present a nitrogen concentration of 2.0 g/l in the nutrient environment, the growing rate is 0.54 cm, as in case of the roots at the same nitrogen concentration, the growing rate is only 0.28 cm, these aspects being presented in Table 2.

The stimulator effect of cytokinine on the growing of the roots is obvious, as it is more intensive where the nitrogen concentration has the highest value.

It can be remarked that the average of the growing rate in the case of the samples that comprise cytokinine 1% is higher than in the case of the samples which do not comprise growing phytohormones.

In case of nitrogen deficiency the growing rate of seedlings is 0.2 cm, in case cytokinine are present in 1% concentration and only 0.05 cm in case cytokinine are missing from the nutrient environment, these aspects being presented in Table 2.

The cytokinine influence the growing, by the stimulation of the cells division and by the elongation of the existing cells.

Comparing the averages of the growing rate of the shots that comprise cytokinine 1%, and the averages of the growing rate of the shots that do not comprise cytokinine in the environment, for the same concentration of nitrogen, one can remark the stimulator effect of cytokinine on the corn seedlings shots.

By comparing among the percentages of the growing of seedlings, for the same nitrogen concentration it can be noted that in case of the samples that contain cytokinine 1%, the percentage of growing is higher than the sample in which cytokinine are missing, these aspects being presented in Table 2.

To be noted the stimulator effect of cytokinine on the plants which grow in an environment with nitrogen deficiency.

The last variant of study was that, in which a cytokinine concentration of 0.1% was introduced into the nutritious environment.

The obtained results show that in case of cytokinine 1% also a proportion between the nitrogen concentration and the corn seedlings length is maintained.

Although the cytokinine concentration is low, just 0.1%, the stimulating effect of cytokinine is preserved on the plants that do not display nitrogen in the nutritious environment.

The stimulating effect of cytokinine on corn seedlings roots is obvious even at low concentrations.

Comparing the different variants, one could remark that the average of the growing rate in the case of the variant with cytokinine 0.1% is 0.39, and in the case of the variant with cytokinine 1% it is 0.45 and 0.36 in case of the control sample (Table 2).

In this case is noted also that cytokinine stimulate the growing of shots which do not present a nitrogen deficiency, this fact allows us to ascertain that cytokinine stimulate the increase of the fresh weight of plants, influencing the events that lead to the starting of mitosis.

The role of phytohormones in the life of plants was studied by more researchers [6], who made research on hormonal factors produced by plants and fungi in mycorrhizal associations. They found that on the one hand, growth hormones in roots and their exudates influence the metabolism and growth of fungi, and on the other, fungal hormones influence root morphology, metabolic changes and the growth of the entire plant.

In other example [5], they inoculated biological formulations that combine a stable microorganism population and various types of compounds produced and released during fermentation, such as phytohormones *Azospirillum brasilense* strain Az39 and *Brayrhizobium japonicum* strain E109, which produce indole 3-acetic acid (IAA), gibberellic acid (GA3) and zeatin (Z). They tested the hypothesis that such compounds are responsible for early growth promotion of roots in inoculated corn (*Zea mays* L.) and soybean (*Glycine max* L.) seedlings. Seeds were inoculated with Az39, E109, or both, and kept in a chamber at 20–30 °C under a controlled photoperiod to evaluate seed germination. Both strains were able to excrete IAA, GA3 and Z into the culture medium, at a concentration sufficient to produce morphological and physiological changes in young seed tissues, promoting the early development of corn and soybean seedlings.

Coming back to the performed study we could state that there is a direct proportionality between the growing rate of the corn seedlings and the nitrogen concentration.

Cytokinine have a stimulating action upon the growing processes of the corn seedlings, especially in the case of a nitrogen absence.

Both in 1% and 0.1% concentration they stimulate the growing of roots and shots that present a nitrogen absence.

The above presented aspects can be explained by the fact that cytokinine stimulate the biosynthesis of nucleic acids, they stimulate the activity of enzymes, the transport and accumulation of some organic and inorganic compounds, they stimulate the photosynthesis, they stimulate the transportation of ions through membranes, they increase the strength of the plants against the toxic action of some chemical substances, etc.

These results confirm the fact that cytokinine have the characteristic of stimulating the cytokinesis, thus concurring to the stimulation of the growing process.

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