THE INFLUENCE OF SEVERAL GROWTH REGULATORS ON GROWTH, DEVELOPMENT AND SENESCENCE IN BEANS (Phaseolus vulgaris)

CRISTINA DOBROTĂ, ARMERIA VICOL, EMILIA BECHIȘ, MIHAI TRIFU

Introduction. Growth regulators play in many biochemical reactions that are essential for plant life. This paper intends to establish the relationship between the mineral nutrition of beans plants under the influence of hormonal treatment and phases of plant life cycle as: growth, development and senescence.

The mineral content of plants varies largely during their vegetation period, according to several physical and chemical factors, e.g. the climatic conditions and the mineral content of the soil, and to biological factors, such as the genetic potential of the plant species and the interactions with microorganisms.

The chemical composition of plants changes during their vegetation period. Thus, the main target of degradation that accompanies aging is represented by proteins and lipids. Ribulose 1,5 - diphosphate carboxylase (Rubisco) is one the proteins that are hydrolysed during senescence (Thayer et al., 1987). it presents 50% of all the soluble proteins of leaves. This enzyme is involved in carbon dioxide fixation and simultaneously represents a major source of mobile nitrogen.

A high concentration of nitrogen and potassium delays aging. Rubisco degradation is directly correlated with senescence (Makino et al., 1984). Dalliny (1987) suggested that free radicale generated during celular oxidations react with Rubisco, and induce various structural changes of proteins, that are then more easly attached by proteases. Growth regulators act at the free radical level. Citokinins are the first phytohormones to be characterized as antisenescent (Richmond, 1987) and antioxidant (Lashem et al., 1979). Subsequent reserch showed that their comounds such as auxins and gibberellins act in a way similar to that of citokinins. Abscisic acid has an opposite effect, as it inhibits protein and nucleic acid biosynthesis and blocks the activity of may enzymes.

The experiments presented in this paper deal with the effect of naphtylacetic acid (NAA), benzyladenine (BA), gibberellic acid (GA_3) and abscisic acid (ABA) on plant growth, leaf starch content and plant senescence expressed by the nitrogen content of the plant material.

Materials and methods. Bean seeds (*Phaseolus vulgaris* L.) were soaked in water for 6 hours and then placed in germinators, on filter paper, under natural light conditions and a constant temperature of 20 ± 1°C. After they germinated, the seeds were transferred to a complete nutritive medium for 48 hours. Then, plantlets of similar size were placed on nutritive media without nitrogen, or with four levels of nitrogen: 5, 15, 25 and 35% / day.

The fresh weight of plants was determined after 10 days, and the relative growth rate was computed according to the following formula:

$RGR = 100 (\ln w_2 - \ln w_1) / (t_2 - t_1)$ where w_2 and w_1 are the fresh weight determined at start (t_1) and harvest (t_2), respectively.

Then, the plant material was dried at 70°C for 48 hours and dry matter determined for roots stems and leaves. The nitrates from the dry plant material were determined with phenoldisulphonic acid, by photometric measurements at 410 nm. Starch was also determined by enzymatic hydrolysis under the action of amylogiucoxidase followed by photometry at 340 nm.

The distribution of dry matter and nitrogen in the plant organs was monitored for plants supplied with insufficient nitrogen.

Another experiment consisted in using culture media supplimented with various growth regulators, such as:

1) NAA - 100 mg/l
2) BA - 100 mg/l
3) GA_3 - 100 mg/l
4) ABA - 100 mg/l

The media were replaced daily and the measurement taken after 10 days. thes, bean plants grown in the field were analyzed as to their growth dynamics, nitrogen content and yield characteristics.

Results and discussions. The results expressing the relationship between nitrogen supply and plant relative growth rate (RGR) are presented in Table 1.

As it is reflected in the table 1, there is a direct proportion between the amount introduced in the culture medium and the relative growth rate of the plants. At the beginning of the treatment with suboptimal nitrogen levels, plant growth rate is higher that the one allowed by the nitrogen

Table 1

Average relative growth rate (RGR, % / day) of dry weight of seedlings, leaves and roots during the experimental period at varied nitrogen addition rates (R_N, % /day)

Nitrogen addition rate (% /day)	Relative growth rate (% /day)		
	seedlings	leaves	roots
5	4.4	3.2	4.8
15	16.8	16.4	19.6
25	22	21.6	25.6
35	32.5	31.6	33.2

introduced in the medium, but can be explained by the initial nutritive reserves of the plant material.

Table 2 showe dry matter and nitrate distribution among bean plant organs. It can be noticed that at low nitrogen levels introduced in the culture medium, more than 60% of the dry matter and nitrate accumulate in the roots. As the nitrogen content of the medium grows, dry matter and nitrates are redistributed along the plant. Thus, at 35% nitrogen introduced in the medium, 22% of the dry matter and nitrates ate found in the roots, while 66.3% are concentrated in the leaves.

The ways in which growth regulators influence plant growh and nitrate and starch accumulation are presented in Table 3. It shows that phytohormones (with the exception of ABA) stimulate plant growth, mainly in the case of a severe nitrogen deficiency. As nitrogen levels in the nutritive medium rise, the differences diminish, but the stimulation is still obvious. ABA determined a highly slow growth rate of plants and changes in their morphology such as: small height, wrinkled, yellow leaves and short petiole. There is a negative correlation between plant starch content and thei relative growth rate. Thus, under severe nitrogen deficiency conditions, starch accumulates. If treated with hormones, the plants still maintain the negative correlation, but at lower values than that of the control.

Table 2

Distribution of dry matter and NO3 between leaves, stems and roots at the end of experimental period at varied addition rates of nitrogen (RN, % /day)

Nitrogen addition rate (% /day)	Plant organs (% of total amount)					
	leaves		stems		roots	
	DW	NO_3	DW	NO_3	DW	NO_3
5	26.2	29.3	10.3	5.90	62.5	[illegible]
15	40.55	42.20	12.12	6.40	47.30	48.20
25	52.4	60.5	13.00	6.90	34.6	33.50
35	64.33	66.32	13.46	7.60	22.15	26.08

Table 3

The influence of phytohormonal treatment on the growth and starch content at beans plants

Nitrogen addition rate (% /day)	Variants	Relative growth rate (% /day)	Starch content mg/g DW
5	Control	4.4	180
	ANA	6.5	148
	BA	7.1	118
	GA_3	6.4	103
	ABA	3.3	182
15	Control	16.8	165
	ANA	17.6	109
	BA	18.1	101
	GA_3	17.9	68
	ABA	12.6	171
25	Control	22	130
	ANA	22.3	111
	BA	24.1	68
	GA_3	22.8	43
	ABA	15.1	138
35	Control	32.5	96
	ANA	33.6	106
	BA	33.4	49
	GA_3	32	47
	ABA	19.9	112

Table 4

The relationship between hormonal treatment and growth at bean plants

Treatment	roots(g)						leaves (g)					
	fresh weight			dry weight			fresh weight			dry weight		
	30 day	60 day	90 day	30 day	60 day	90 day	30 day	60 day	90 day	30 day	60 day	90 day
Control	3.9	4.2	4.3	1.1	1.4	1.6	42.	49.2	41.8	7.1	10.1	10.4
ANA	2.5	5.4	5.3	0.2	2.2	5.4	46	55.0	51.9	7.8	11.8	12.4
BA	3.9	6.3	6.4	0.8	2.0	6.6	47.5	59.5	53.0	9.0	12.1	12.6
GA_3	4.1	6.0	5.9	0.9	2.1	6.0	47	58.0	52.0	9.1	12.2	12.4
ABA	2.4	3.0	3.2	0.2	0.8	1.1	31	33.0	29.8	6.2	7.0	7.2

The results dealing with the dynamics of bean plant growth under field conditions are presented in table 4 and 5. Growth of these plants followe a pattern similar to that of plants grown in the lab. As the plants grow, soil nitrogen supply decreases. This is then reflected by the low nitrate and the high starch content of these plants.

Table 5

The relationship between hormonal treatment and nitrate and starch content at bean plants

Treatment	Nitrate content (%)	Starch content mg/g D.W.
Control	100	196
ANA	113.4	158.5
BA	178	106.2
GA_3	176.3	103.4
ABA	21.2	220

Of the hormones, BA has a highly antisenescent action, the nitrogen level of the plant being kept high, as compared to both the control and the other treatmens. On the contrary, ABA has a strong inhibitory on plant nitrate content, which helps to explain ABA ability to induce plant senescence.

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Rezumat

Scopul acestei lucrări este stabilirea relației existente între regimul nutriției minerale a plantelor sub influența tratamentului hormonal și etapele ciclului vital al plantelor, respectiv creșterea, dezvoltarea și senescența.

S-a urmărit efectul acidului naftilacetic (ANA), a benziladeninei (BA), acidului giberelic (GA_3) și a acidului abscisic (ABA), asupra creșterii plantelor, conținutul frunzelor în amidon și asupra senescenței - estimată prin conținutul în azot al materialului vegetal. S-au stabilit de asemenea, corelațiile existente între doza de azot și rata relativă de creștere a plantei, distribuția substanței uscate și a azotațiilor în organele plantei, și conținutul în amidon.