

## RESEARCH INTO THE INFLUENCE OF PHYTOHORMONES UPON THE GROWTH „*IN VITRO*” AT SEVERAL VARIETIES OF GREENHOUSE CARNATIONS

Cristean, Diana

Babes-Bolyai University, Faculty of Biology, 44 Gh. Bilascu St.,  
Cluj-Napoca, Romania

Review by Doru Pamfil, M. Trifu

**Abstract.** After using treatments with seven phytohormones on four varieties of greenhouse carnations (Caribe, Red Corso, Nelson, Francesca) it was discovered that AIA and GA3 hormones stimulated the growth in height of the plantlets; GA3, AIA and NAA promoted the growth of the internodes, but the highest medium number of internodes per plantlet was registered after using treatments with NAA and AIA hormones. The concentration level of phytohormones used in the experiment also influenced the stimulating effects of these hormones over the characteristics that we watched closely. Treatments with BAP and KIN had the weakest influence, determining only a slight growth in height of the Caribe plantlets and almost not at all at other varieties.

**Key words:** carnation, „*in vitro*”, growth, plantlets, phytohormones

### INTRODUCTION

Although they are used in small quantities in horticulture, phytohormones have a great effect upon the process of growing and development of plants especially when these are still young. Phytohormonal treatments used in cultural mediums for the *in vitro* multiplication of greenhouse carnations have positive effects upon the growth and development of plantlets (1, 2, 3, 4, 5, 6, 7, 8, 9).

### MATERIALS AND METHODS

The biologic material used in the experiment was represented by meristems taken from four varieties of young greenhouse carnations: Caribe, Red Corso, Nelson and Francesca. The meristems were inoculated on a Murashige-Skoog (1962) medium, in which were added seven types of phytohormones, each in four concentrations. We watched over the effect of hormones and concentrations upon the proliferation of plantlets, taking measurements every six weeks after the inoculation. It has been measured: the growth in height of plantlets, the length of internodes and each plantlet's number of internodes.

General information on the effect of growth regulators upon carnation plantlets that were grown *in vitro*, for all the multiplied varieties on a meristematic way in the experiment, was obtained after calculating and determining the average of the character on each hormone, the differences between the average height of plantlets taking into consideration the hormones' control and the meaning of the results obtained, for the important difference of 5% (DS 5%).

## RESULTS AND DISCUSSIONS

The results concerning the control of the hormones used upon the growth in height are presented in table no.1.

Table 1

A hormone's control over the medium growth of four varieties of greenhouse carnations' plantlets (Duncan test)

Hormone used	Plantlet height (cm), depending on varieties of carnations				Average/ Hormone
	Caribe	Red Corso	Nelson	Francesca	
AIA	5,54 <sup>a</sup>	1,47 <sup>c</sup>	5,00 <sup>b</sup>	5,67 <sup>b</sup>	4,42
NAA	3,71 <sup>c</sup>	1,98 <sup>a</sup>	4,92 <sup>b</sup>	4,71 <sup>c</sup>	3,83
IBA	2,50 <sup>e</sup>	0,66 <sup>d</sup>	1,76 <sup>e</sup>	2,78 <sup>e</sup>	1,93
BAP	1,63 <sup>f</sup>	1,50 <sup>c</sup>	2,08 <sup>d</sup>	2,09 <sup>f</sup>	1,83
Kin	3,03 <sup>d</sup>	1,78 <sup>b</sup>	2,53 <sup>c</sup>	4,63 <sup>c</sup>	2,99
Zea	4,20 <sup>b</sup>	1,55 <sup>c</sup>	2,65 <sup>c</sup>	3,16 <sup>d</sup>	2,89
GA3	3,50 <sup>c</sup>	1,53 <sup>c</sup>	5,67 <sup>a</sup>	6,08 <sup>a</sup>	4,20
Ds 5%	0,28-0,32	0,11-0,13	0,30-0,34	0,33-0,38	0,26-0,29

\* The difference between any two variants followed by a common letter is insignificant

The AIA and GA3 hormones promote the most powerful growth of plantlets (medium values in the experiment were 4,42 cm and 4,20 cm). Between these hormones' control over the character it does not exist a real difference, assured by a statistic point of view, but both of them determined a superior growth, taking into consideration the other hormones used in the experiment. After these regulators, having the same effect upon the growth of plantlets was situated the NAA hormone with 3,83 cm, height that represents an important inferior difference to the values recorded by adding in the cultural mediums the AIA and GA3 hormones, but a superior one tagging into consideration the results recorded after adding Kin and Zea regulators, these making an homogene group (with values of the character without important exceptions).

The weakest hormones were IBA and BAP (the values recorded were the most inferior). The medium values of the character under the influence of these two hormones were very close (1,93cm and 1,83cm) without a difference that was statistically assured between them, but were really inferior considering the rest of the phyto regulators used.

In table number 2 are presented the results recorded taking into consideration the effect of hormones upon the medium length of the greenhouse carnation plantlets' internodes.

Table 2

A hormone's control over the average length of internodes, at greenhouse carnations' plantlets (Duncan test)

Hormone used	Internodes' length (cm), depending on varieties of carnations				Average/ Hormone
	Caribe	Red Corso	Nelson	Francesca	
AIA	1,43 <sup>b</sup>	0,63 <sup>c</sup>	1,82 <sup>b</sup>	1,78 <sup>a</sup>	1,41 B
NAA	0,87 <sup>cd</sup>	1,60 <sup>a</sup>	1,23 <sup>c</sup>	1,23 <sup>cd</sup>	1,23 C
IBA	1,38 <sup>b</sup>	0,37 <sup>d</sup>	0,52 <sup>f</sup>	0,83 <sup>c</sup>	0,77 E
BAP	0,78 <sup>d</sup>	0,58 <sup>c</sup>	1,04 <sup>d</sup>	1,28 <sup>bc</sup>	0,92 D
Kin	0,98 <sup>c</sup>	0,59 <sup>c</sup>	1,18 <sup>c</sup>	1,38 <sup>b</sup>	1,03 D
Zea	0,89 <sup>cd</sup>	0,41 <sup>d</sup>	0,71 <sup>e</sup>	1,13 <sup>d</sup>	0,78 E
GA3	2,18 <sup>a</sup>	0,78 <sup>b</sup>	2,09 <sup>a</sup>	1,89 <sup>a</sup>	1,74 A
Ds 5%	0,16-0,18	0,07-0,09	0,11-0,13	0,12-0,14	0,12-0,14

\* The difference between any two variants followed by a common letter is insignificant

There have been recorded important differences not only taking into consideration the hormone used, but also between varieties. The Duncan test had been used for illustrating the differences controlled by a hormone at the same specie and illustrating the hormones' control per the total of all varieties. The medium of the character was calculated taking into consideration each hormone and the meaning of the 5% (DS 5%) difference was recorded.

In the end the highest growth of internodes was controlled by GA3 (1,74 cm), AIA (1,41 cm) and NAA (1,23 cm), while the smallest growth of internodes was controlled by IBA (0,77 cm) and BAP (0,92 cm) as the statistics assured this.

Considering the number of internodes important differences were recorded both between varieties and hormones used, the results being systematized in table 3.

Table 3

The effect of hormones upon the medium number of internodes per plantlet at four varieties of carnations

Hormone used	The medium number of internodes/ plantlet, depending on variety				Average/ Hormone
	Caribe	Red Corso	Nelson	Francesca	
AIA	3,83 <sup>a</sup>	2,17 <sup>a</sup>	2,83 <sup>c</sup>	3,06 <sup>b</sup>	2,97 A
NAA	4,17 <sup>a</sup>	1,00 <sup>b</sup>	3,88 <sup>a</sup>	3,67 <sup>a</sup>	3,18 A
IBA	1,38 <sup>c</sup>	1,00 <sup>b</sup>	3,00 <sup>b</sup>	3,29 <sup>b</sup>	2,17 C
BAP	1,63 <sup>c</sup>	0,50 <sup>c</sup>	1,50 <sup>c</sup>	1,38 <sup>c</sup>	1,25 D
Kin	1,50 <sup>bc</sup>	0,50 <sup>c</sup>	1,50 <sup>c</sup>	1,72 <sup>c</sup>	1,30 D
Zea	3,88 <sup>a</sup>	0,25 <sup>d</sup>	3,08 <sup>b</sup>	2,96 <sup>b</sup>	2,54 B
GA3	1,75 <sup>b</sup>	0,50 <sup>c</sup>	2,50 <sup>d</sup>	3,13 <sup>b</sup>	1,97 C
Ds 5%	0,35-0,40	0,06-0,07	0,11-0,13	0,38-0,43	0,22-0,26

\* The difference between any two variants followed by a common letter is insignificant

The highest medium number of internodes per plantlet was registered after using treatments with NAA (3,18 internodes) and AIA (2,97 internodes) both having superior exceptions, important considering the rest of the treatments. They were followed by GA3 (1,97 internodes), Kin (1,30 internodes) and BAP (1,25 internodes). The last two hormones (BAP and Kin) controlled in the weakest way the development process of internodes considering the other hormones added in the cultural medium.

The results recorded in the experiment considering the effect of the concentration level of the hormones used for the growth of greenhouse carnation plantlets are presented in table number 4.

Table 4

The effect of the concentration used upon the medium height of plantlets, at four varieties of carnations

Concentration used	Plantlet's height (cm), depending on variety				Average/ concentrations
	Caribe	Red Corso	Nelson	Francesca	
0,1 mg/l	1,99 <sup>d</sup>	0,92 <sup>d</sup>	2,37 <sup>d</sup>	2,73 <sup>d</sup>	2,00 D
0,5 mg/l	2,55 <sup>c</sup>	1,17 <sup>c</sup>	2,63 <sup>c</sup>	3,18 <sup>c</sup>	2,38 C
1,0 mg/l	4,14 <sup>b</sup>	1,70 <sup>b</sup>	4,05 <sup>b</sup>	4,56 <sup>b</sup>	3,61 B
2,0 mg/l	5,10 <sup>a</sup>	2,18 <sup>a</sup>	5,01 <sup>a</sup>	6,18 <sup>a</sup>	4,62 A
DS 5%	0,21-0,23	0,09	0,23-0,24	0,25-0,27	0,19-0,21

\* The difference between any two variants followed by a common letter is insignificant

Between the four quantities of hormones that were added in the cultural mediums some real differences were noticed analysing their effect upon the plantlets' height, the medium value of the character increasing simultaneously with the concentration.

The highest values of plantlets' heights, at all the varieties studied (4,62 cm), were assured by the maximum dose used, of 2,0 mg/l. The media per experiment of plantlets' height at a concentration of 2,0 mg/l would have been substantially higher, if it wouldn't have been considered the results recorded at the Red Corso variety, which decreased a lot the final media.

The effect of the hormones' concentrations used, upon the internodes' length are presented in table 5.

Table 5

The effect of the concentration used upon the medium length of internodes, at four varieties of carnations

Concentration used	Internodes' length (cm), depending on variety				Average/ concentrations
	Caribe	Red Corso	Nelson	Francesca	
0,1 mg/l	0,97 <sup>d</sup>	0,32 <sup>c</sup>	1,03 <sup>c</sup>	1,24 <sup>c</sup>	0,89 C
0,5 mg/l	1,10 <sup>c</sup>	1,32 <sup>c</sup>	1,09 <sup>c</sup>	1,13 <sup>d</sup>	0,91 C
1,0 mg/l	1,27 <sup>b</sup>	1,90 <sup>b</sup>	1,34 <sup>b</sup>	1,36 <sup>b</sup>	1,22 B
2,0 mg/l	1,53 <sup>a</sup>	1,30 <sup>a</sup>	1,44 <sup>a</sup>	1,70 <sup>a</sup>	1,49 A
DS 5%	0,12-0,13	0,06	0,08-0,09	0,09-0,10	0,09-0,10

\* The difference between any two variants followed by a common letter is insignificant

The internodes length has changed because of the used hormones' concentrations and because of the variety of carnations that has been analysed.

The growing of the internodes was progressive during the research; they were proportional with the concentrations used, the media having values between 0,89 cm (for the minimum concentration of hormones, which was of 0,1 mg/l) and 1,49 cm (for the maximum concentration of hormones, which was of 2,0 mg/l). Important differences were noticed between the concentrations of 0,1 and 0,5 mg/l, which controlled in a real but inferior way the internodes' length, taking into consideration the superior concentrations. The effect of the hormones' concentrations upon the medium number of internodes per plantlet at the four varieties of carnations is presented in table number 6.

Table 6

The effect of the concentration used upon the medium number of internodes/plantlet, at four varieties of carnations

Concentration used	No of internodes/ plantlet, depending on variety				Average/ concentrations
	Caribe	Red Corso	Nelson	Francesca	
0,1 mg/l	1,90 <sup>c</sup>	0,57 <sup>c</sup>	1,95 <sup>d</sup>	2,00 <sup>d</sup>	1,61 D
0,5 mg/l	2,10 <sup>c</sup>	1,57 <sup>c</sup>	2,26 <sup>c</sup>	2,52 <sup>c</sup>	1,86 C
1,0 mg/l	2,93 <sup>b</sup>	1,05 <sup>b</sup>	2,71 <sup>b</sup>	2,84 <sup>b</sup>	2,38 B
2,0 mg/l	3,43 <sup>a</sup>	1,19 <sup>a</sup>	3,52 <sup>a</sup>	3,61 <sup>a</sup>	2,94 A
DS 5%	0,26-0,28	0,05	0,08-0,09	0,28-0,31	0,17-0,18

\* The difference between any two variants followed by a common letter is insignificant

At all the four varieties of carnations the medium number of internodes grew simultaneously with the increase of the hormones' concentrations used.

The medium number of internodes at all varieties treated with a concentration of 0,1 mg/l was 1,61. The value of the character grew progressively reaching 2,94 at a concentration of 2,0 mg/l. This confirms that using the hormones in different concentrations influences in an important way the development of internodes.

## CONCLUSIONS

At Caribe variety the greatest height growing's were controlled by AIA, NAA and Zea (at concentrations of 1,0 and 2,0 mg/l). The other hormones didn't have an important effect upon these characters.

At Red Corso variety none of the hormones determines a great growth in height of the plantlets, the internodes were short, although the longest were controlled by NAA (at all concentrations) and Zea (at a concentration of 2,0 mg/l). At some plants were no internodes at all, with a media of 2,33 per plantlet being registered only after using the AIA (0,1-0,2 mg/l) hormone, but the internodes had a very small length.

At Nelson variety the best results were registered. There were great height growings both of plantlets and internodes after using GA3, AIA and NAA. The highest medium number of internodes was registered after using AIA, NAA, IBA and Zea.

At Francesca variety the gibberilic acid (2 mg/l) and AIA (1 mg/l) have controlled the best height growings of plantlets; GA3, Zea and AIA determined the length of internodes while NAA, IBA, GA3 (at concentrations of 1,0 and 2,0 mg/l) stimulated the development of a larger number of internodes per plantlet. BAP and Kin had the weakest effect.

Generally the weakest effect upon all these characters was registered after using treatments with BAP and Kin.

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## REZUMAT

### INFLUENȚA FITOHORMONILOR ASUPRA CREȘTERII "IN VITRO" LA CÂTEVA SOIURI DE GAROAFE DE SERA

După utilizarea tratamentelor cu fitohormoni la patru soiuri de garoafe de seră (Caribe, Red Corso, Nelson, Francesca) s-a constatat că hormonii AIA și GA3 au stimulat creșterea în înălțime a plântuțelor, hormonii GA3, AIA și NAA au produs alungirea internodurilor. Cel mai mare număr mediu de internoduri/plântuță s-a înregistrat în cazul tratamentelor cu NAA și AIA. Nivelul de concentrație al fitohormonilor folosiți în experiment a influențat caracteristicile de creștere analizate. Tratamentele cu BAP și KIN au avut cea mai slabă influență asupra creșterii "in vitro", determinând doar o creștere ușoară în înălțime a plantulelor soiului Caribe; aceleași tratamente nu au avut un effect semnificativ asupra creșterii plantulelor la celelalte soiuri.