

EFFECT OF *IN VIVO* TREATMENTS WITH GA₃ FOR PRODUCTION *DE NOVO* SPROUTS IN SEED AND MERCANTILE POTATO

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Abstract: This paper presents results on the effect of different growth regulators on microtuberization induction in several varieties of seed and commercial potato (*Solanum tuberosum* L.) *in vivo*. The seed potatoes of the varieties Dido, Marabel, Agria and Agriko and commercial potatoes of the varieties Agria SR, Agria BE and Andrea were used in the experiment.

Key words: *in vivo*, potato, genotype, treatment

Introduction

Potato is the fourth important crop in the world after wheat, rice and maize. Potatoes are thought to have originated from high - mountain ranges of the Andes in South America. This crop is grown in 180 countries worldwide. According to the FAO statistic (<https://faostat.fao.org>), the largest producer of potatoes is Asia, then Europe, South America and North and Central America.

The very early beginning of potato cultivation in Macedonia is dating back 150-170 years ago. Today in the country, potatoes are grown on more than 13,000 hectares with an average yield of 20-40 t/ha, and every year the area of potato cultivation is extended (Statistical Yearbook of Republic of Macedonia, 2014).

Productivity of the tuber for obtaining sprouts depends of many factors like: length of the day, temperature, physiological maturity of potato, water supply, growth regulators on plants (Gregory, 1965.).

Growth regulators have important and usefull effects on productivity of the tuber and that is linked with the hormonal balance (Stuart i Cathey, 1961.; Vreugdenhil i Struik, 2006.).

According to Rehman i rad., (2001) and Burton (1989) the treatment on the tubers with gibberellic acid GA₃, shows that the tubers have fast sprouting and must importantly is that they provide most number of sprouts.

The treatment on the tubers with GA₃ gets excellent results compared to those tubers which aren't treated with this growth regulator, because germination was slower and later, this was confirmed by researching of Timm i sar., (1962.).

According to researchment of Hu i sar.,(1998) which are examined the role of gibberellic acid, abscisic acid and sucrose into regulation of formation of tubers *in vitro* potato, they are getting to conclusion that GA₃ shows like one of the better phytohormones during the tuberisation of potato.

The role of GA₃for production of sprouts is very important. In the studied that are performed on potato, GA₃ mainly is applied externally. These studies shows that with

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the application of GA₃ are increasing growth and elongation of sprouts, and inhibiting obtaining of microtubers in medium (Smith i Rappaport, 1969; Kumar i Wareing, 1972).

Treating on tubers with GA₃ sprouts are growing faster and they produced much more sprouts opposed of untreated tubers (Rehman i rad., 2001; Burton, 1989).

Material and methods

The experiment was conducted in the Laboratory of Plant Biotechnology, Faculty of Agriculture, Goce Delcev University – Stip, Macedonia. The following potato varieties were used as starting material for the experiment:

- seed potatoes: Dido, Marabel, Agria, Ambition and Agriko;
- commercial potatoes: Agria SR, Agria BE and Andrea.

The variety Agria SR is cultivated in Strumica region, while the variety Agria BE is cultivated in Berovo region. The two regions differ in altitude, soil types and climate, thus the commercial potatoes of the same variety were treated as different starting material.

In vivo treatment of potato tubers with GA₃

Tubers of different potato seed and commercial varieties used in the experiment were treated with different concentrations of GA₃: 2, 12 and 22 ppm. To determine whether GA₃ had effect on sprouts emergence, a control K was used, where the tubers were not treated with GA₃ (Figure 1).

The GA₃ treatment was used for induction of rapid emergence and germination of sprouts. After GA₃ treatment, one week old sprouts were detached from the potato tubers and they were used as starting explants for further in vitro cultivation on MS medium enriched with different concentrations of phytohormones.

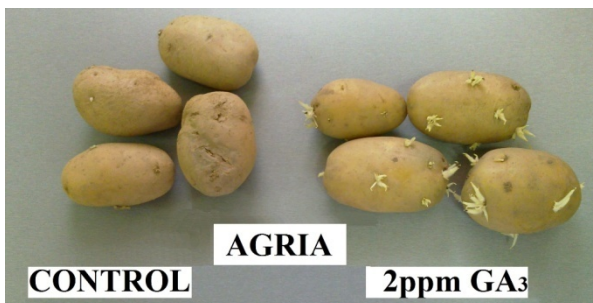


Figure 1. The effect of treatment with 2 ppm GA₃ for rapid sprouting and *de novo* production of sprouts in variety Agria compared to the control

Data analysis

All data were subjected to statistical analysis with IBM SPSS Statistical 21, one-way ANOVA and Duncan *posthoc* test, with the level of significance 0.05%.

Results and discussion

The results with this treatment with GA₃ in seed and mercantile potato are shown in Table 1.

Table 1. Effect of *in vivo* treatments with GA₃ for production *de novo* sprouts in seed and mercantile potato

Production of sprouts						
GA ₃ treatment	Genotype	Number of sprouts per tuber	Number of sprouts per eyelet	Length of sprouts (mm)	Width of sprouts (mm)	% of sprouts formation
Control	<i>Agria</i>	18	1,00c	2,61a	1,11bc	58,33f
	<i>Agriko</i>	19	1,00c	3,73a	1,00c	53,33e
	<i>Andrea</i>	6	1,00c	2,66a	1,00c	50,00d
	<i>Ambition</i>	13	1,00c	3,23a	1,23bc	31,25b
	<i>Dido</i>	12	2,33a	3,87a	1,50abc	50,00d
	<i>Marabel</i>	18	1,83ab	3,72a	1,42abc	64,00g
	<i>agria BE</i>	3	1,33bc	3,33a	1,66ab	25,00a
2 ppm	<i>agria SR</i>	2	1,00c	3,00a	2,00a	33,33c
	<i>Agria</i>	34	1,34b	2,29de	1,29b	76,93h
	<i>Agriko</i>	22	1,00c	5,95a	1,86ab	73,33d
	<i>Andrea</i>	10	1,20c	2,70cde	1,60ab	75,00e
	<i>Ambition</i>	19	1,10c	3,53bcd	1,57ab	35,29a
	<i>Dido</i>	16	2,93a	1,81e	1,66ab	76,90g
	<i>Marabel</i>	28	1,96b	3,85bc	1,92ab	76,00f
12 ppm	<i>agria BE</i>	8	1,12c	4,75ab	1,62ab	50,00b
	<i>agria SR</i>	5	1,20c	6,00a	2,20a	66,66c
	<i>Agria</i>	31	1,62ab	4,80b	2,03bcd	81,81d
	<i>Agriko</i>	33	1,29b	4,39bc	1,75cd	73,33b
	<i>Andrea</i>	12	1,57ab	2,75c	1,75cd	75,00c
	<i>Ambition</i>	22	1,86ab	5,77ab	1,86ab	50,00a
	<i>Dido</i>	25	1,66ab	2,72c	1,52d	91,66f
22 ppm	<i>Marabel</i>	33	1,92ab	5,03ab	2,45b	88,46e
	<i>agria BE</i>	12	1,60ab	4,33bc	2,16bc	75,00c
	<i>agria SR</i>	7	2,20a	6,71a	3,00a	100,00g
	<i>Agria</i>	43	1,00c	4,95bc	1,88c	100,00c
	<i>Agriko</i>	38	1,05c	4,57bc	1,86c	87,50b
	<i>Andrea</i>	19	1,21c	3,10c	1,89c	100,00c
	<i>Ambition</i>	23	1,17c	6,52b	2,69ab	62,50a
22 ppm	<i>Dido</i>	29	1,96a	2,81c	1,60c	100,00c
	<i>Marabel</i>	40	1,65b	9,57a	2,47b	100,00c
	<i>agria BE</i>	17	1,05c	4,58bc	3,17a	100,00c
	<i>agria SR</i>	10	1,20c	6,90b	3,10a	100,00c

For stimulation of formation of sprouts, tubers were treated with GA₃ with different concentration like: 2 ppm, 12 ppm and 22 ppm. Also was one group of tubers that weren't treated with GA₃ and it was named like control group, which was treated with distilled water.

In control group, the production of sprouts, the best genotype is shown mercantile genotype *marabel* with 64% of formed sprouts, unless the treated genotype with 2 ppm GA₃ the higher value shown seed genotype *agria* with 76,93% formed sprouts.

In treatment with 12 ppm GA₃ the best value shown mercantile genotype *agria SR* with 100% formed sprouts.

The treatment of genotypes with 22 ppm GA₃ has given the greatest results at the most seed genotypes like: *agria*, *dido*, *marabel*; mercantile genotypes like: *andrea*, *agria BE*, *agria SR* with 100% formed sprouts.

Genotype *marabel* features with the highest percentage (64%) of formed sprouts within treatment with GA₃.

Genotype *dido* has given 2,33 sprouts per eyelet which represent the best value for this parameter and significantly is varies from the numbers of sprout per eyelet in all other genotypes.

The length of formed sprouts is the largest on genotype *dido* (3,87 mm), but within significantly difference compared to the length of sprouts obtained from the others genotypes. Width of sprouts from 2 mm is the biggest on genotype *agria SR* and the same significantly differs from the width of sprouts of genotypes *agria* (1,11 mm), *agriko* (1 mm), *andrea* (1 mm) and *ambition* (1,23 mm).

The length of sprouts is the biggest on genotype *agria SR* (6 mm) and significantly differs from the length of sprouts on genotype *dido* (1,81 mm) with the treatment with 2 ppm GA₃.

The width of sprouts from 2,20 mm is the biggest of genotype *agria SR* and significantly is differs from the width of sprouts on genotype *agria* (1,29 mm), which the production of sprouts is stimulated with 2 ppm GA₃.

With the same treatment the genotype *dido* has shown 2,93 sprouts per eyelet which represent the best value for this parameter and significantly is differs from the numbers of sprouts per eyelet from all other genotypes..

The fact that gibberellins stimulated the production of sprouts on potato it is researched and verified from Clegg i Rappaport (1970); Claassenes i Vreugdenhill (2000.).

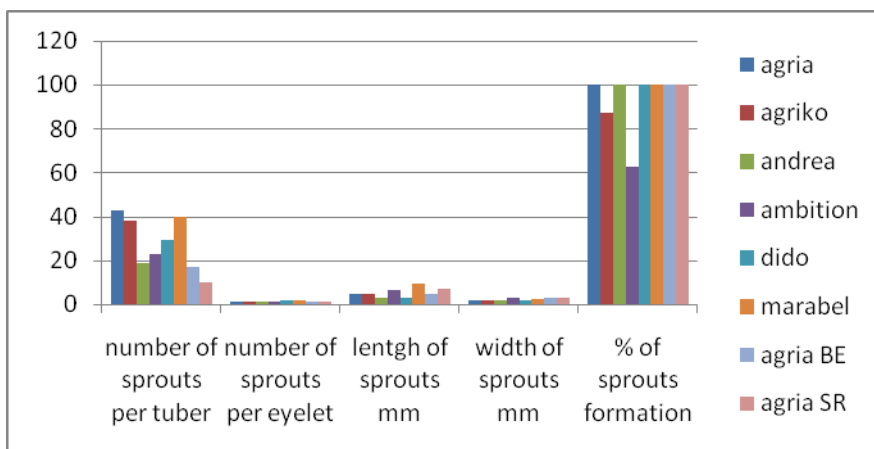
With the treatment of sprouts with 12 ppm GA₃ it is noticed that the number of sprouts per eyelet significantly shows the best value genotype *agria SR* with 2,20 sprouts per eyelet, which value significantly differs from the obtained values from the all other genotypes.

The width of sprouts is the best on genotype *agria SR* (3 mm), which significantly differs from the width of sprouts from the genotype *dido* (1,52 mm).

With the lowest values of length of sprouts are featured genotypes *dido* (2,72 mm) and *andrea* (2,75 mm), which significantly differs from the value that is obtained on genotype *agria SR* (6,71 mm).

On mercantile potato 100% of sprouts formation are getting on genotypes *andrea* and *agria SR*.

The gibberellins have capacity to end latency of tubers of potato (Herrera i rad., 1991.). The application of GA₃ with the higher concentration increases and lenthens the sprouts (Lorreta i ras., 1995; Marinus i Bodleander, 1987; Rappaport i rad., 1957.).



Graph 1. Production of sprouts from tubers treated with 22 ppm GA₃

With treatment with 22 ppm GA₃ the largest sprouts has genotype *marabel* with 9,57 mm, which significantly is differs from the obtainig values of the others genotypes *dido* (2,81 mm) and *andrea* (3,10 mm).

The genotypes with treatment 22 ppm GA₃ with the best values are representet *agria BE* (3,17 mm) and *agria SR* (3,10 mm) which significantly are differs from the values of all others genotypes.

With the same treatment genotype *dido* has given 1,96 sprouts per eyelet which significantly is differs from the numebr of obtain sprouts per eyelet of all genotypes.

The treatment with 22 ppm GA₃ are shown as the most effective for both types examined potato. The applying of the highest doses of GA₃ results with 100% of sprouts formation on seed potato on the genotypes *dido*, *marabel* and *agria*. On mercantile potato 100% of sprouts formation are getting on genotypes *andrea*, *agria BE* and *agria SR*.

Conclusion

The results of our research indicates that mercantile potato it is more sensitive on the treatment with gibberellic acid and gets bigger percentage of formation of *de novo* sprouts for all tested genotypes and for all applied concentration. From all applied concentration with gibberellic acid the clearest results are obtaining with 22 ppm GA₃.

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