INFLUENCE OF THE NAA PRODUCT ON THE PREMATURE GALA MAST FRUITS DROP AND QUALITY INDICES

INFLUENȚA PRODUSULUI PE BAZĂ DE NAA ASUPRA CĂDERII PREMATURE A FRUCTELOR DIN SOIUL GALA MAST ȘI INDICIELOR DE CALITATE

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Abstract.
The aim is to study the effectiveness of applying grow regulator Obsthormon 24a (NAA) to 'Gala Mast' cultivar in different doses and treatment periods to maintain the physiological balance in the plant and keep the fruit in the crown as much as possible at the time of fruit harvesting. To achieve the stated goal, the following variants were studied: (1) the control (trees sprayed with water only); (2) NAA 15 ppm; (3) NAA 22.5 ppm; (4) NAA 30 ppm; (5) NAA 37.5 ppm; (6) NAA 15+15 ppm; (7) NAA 15+22.5 ppm. To prevent premature fruit drop, to treat with NAA 30 ppm 15 days before harvest, or in two doses of 15 ppm. The first treatment to be applied in the first decade of July, when the differentiation of fruit buds on the apple starts, and the next one 15 days before harvest.
Key words: Firmness, fruit, NAA, productivity.

Rezumat.
Scopul a fost de a studia eficacitatea aplicării regulatorului de creștere Obsthormon 24a (ANA) la soiul „Gala Mast" în diferite doze și perioade de tratament pentru a menține echilibrul fiziologic în plantă și a păstra fructele în coroană pomilor perioadă mai îndelungată înainte de începerea recoltării. Pentru a atinge scopul preconizat, au fost studiate următoarele variante: (1) martor (pomi stropiți numai cu apă); (2) NAA 15 ppm; (3) NAA 22,5 ppm; (4) NAA 30 ppm; (5) NAA 37,5 ppm; (6) NAA 15+15 ppm; (7) NAA 15+22,5 ppm. Pentru a preveni căderea prematură a fructelor sa tratat cu NAA 30 ppm cu 15 zile înainte de recoltare, sau în două doze de 15 ppm. Primul tratament a fost aplicat în prima decadă a lunii iulie, când începe diferențierea mugurilor de rod la măr, iar următorul cu 15 zile înainte de recoltare.
Cuvinte cheie: Fermitate, fruct, ANA, productivitate.

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INTRODUCTION

Preharvest apple drop, which occurs before the fruit has reached optimal color, maturity or size, causes economic losses to the fruit industry. Excluding premature fruits drop during the pre-harvest and harvest period is a useful crop management tool that apple producers must consider every year [Babuc *et.al*., 2013; Peşteanu, 2014a, 2014b].

Premature fruits drop in apple is caused by a sudden increase in endogenous ethylene content at the level of the abscission zone formed between the peduncle and the fruit branch [Greene, 2010; Kuzin *et.al*., 2021].

Each apple cultivar is predisposed in its own way in terms of the tendency to drop before fruit harvest. There are more resistant cultivars and some in which the respective phenomenon is more intense [Peşteanu, 2014a; 2014b].

NAA is a synthetic auxin, hormonal type, which is applied in conditions that favor good foliar absorption, which retains the formation of the suber star in the abscission zone, the connection between the fruit peduncle and the fruit formations is better, which allows to control the preharvest drop [Kuzin *et. al*., 2021; Marini *et. al*. 1993; Peşteanu, 2014a].

Application of auxins has been shown to reduce fruit drop before harvest [Kuzin *et. al*., 2021; Marini *et. al*. 1993; Peşteanu, 2014a].

MATERIAL AND METHOD

The researches were carried out in the intensive apple orchard founded near the village of Paulești, Calarași district, in the drop of 2006 at the "Codru ST" LTD. The object of study was trees of the 'Gala Mast' cultivar grafted on the M9 rootstock. The crown tall spindle, planting distance was 3.5 x 1.2 m. The scheme of experiments to determine the effectiveness of the product Obsthormon 24a (NAA) for the prevention of dropping during the pre-harvest and fruit harvesting period included the following variants: (1) the control (trees sprayed with water only); (2) NAA 15 ppm; (3) NAA 22.5 ppm; (4) NAA 30 ppm; (5) NAA 37.5 ppm; (6) NAA 15+15 ppm; (7) NAA 15+22.5 ppm. The growth regulator was Obsthormon 24a.

On the experimental sector, in accordance with the scheme of experiences, in version one, no intervention was carried out on the trees. In variants two to five, a single treatment with the 1-naphthaleneacetic acid was carried out 15 days before harvest. In variants six and seven, two treatments with the 1-naphthaleneacetic acid were carried out, the first respectively in the first decade of July when the period of differentiation of the fruit buds in the apple culture starts, and the next one 15 days before harvest.

The placement of the plots was done in blocks, each variant having 4 repetitions. Each repetition consisted of 7 trees. At the boundary between the plots and the experimental repetitions, 1 tree was left untreated to avoid the overlap of some variants or repetitions during the treatments

The research was carried out under field and laboratory conditions according to accepted methods of carrying out experiments on fruit crops with growth regulators.

Data were processed using the ANOVA test and STATGRAPHICS Centurion 19.4.04 (Statgraphics Technologies, Inc., The Plains, VA, USA) program. The differences were considered statistically significant if the probability was greater than 95% (p-value < 0.05).

RESULTS AND DISCUSSIONS

The investments made show that the number of fruits in the crown of Gala Mast apple trees varied from 109.0 to 112.0 pcs. (Table 1). The total number of fruits in the crown of apple trees was obtained as a result of chemical fruit thinning supplemented with manual thinning during the period when the diameter of the central trunk in the inflorescence was 18-20 mm.

Regarding the number of fruits left in the crown of the trees, we note that the study indices for the Gala Mast variety ranged from 85.5 to 110.0 pcs.

Table 1

The influence of NAA treatment dose to the Gala Mast variety on the premature fall of fruits in the pre-harvest period in the apple orchard

Variants	Number of fruits, pcs/tree			Average fruit weight, g	
	Total	In the crown	Fallen from the crown	From the crown	Fallen from the crown
Control	109.5 a	96.5 d	13.0 a	154.7a	159.6 b
NAA 15 ppm	109.0 a	104.5 c	4.5 b	155.0a	163.0 a
NAA 22,5 ppm	111.0 a	108.5 a	2.5 c	153.6a	164.1 a
NAA 30 ppm	112.0 a	110.0 a	2.0 c	152.1 b	164.6 a
NAA 37,5 ppm	109.0 a	104.5 c	4.5 b	154.8 a	163.0 a
NAA 15+15 ppm	109.5 a	107.5 b	2.0 c	154.4 a	163.9 a
NAA 15+22,5 ppm	109.5 a	107.0 b	2.5 c	155.4 a	164.2 a
LSD 0.05	2.544	2.353	0.494	1.261	1.758

Also, the number of fruits in the crown of the trees is correlated with the amount of product administered per unit area. If, for example, in the Gala Mast variety, a smaller number of fruits in the crown of the trees was recorded in the control variant, without treatment (96.5 pcs), then higher values were obtained in the variant NAA 30 ppm (110.0 pcs). Insignificantly lower values compared to the previous variant were registered in the variants treated with NAA 15+22.5 ppm (107.0 pcs), NAA 15+15 ppm (107.5 pcs) and NAA 22.5 ppm (108.5 pcs). The variants treated with the NAA 15 ppm and NAA 37.5 ppm have registered recorded values of 104.5 pcs/tree.

The number of fruits that fell on the ground within the varieties taken in the environment in 2016-2017 was different. Higher values of the index were registered in the control variant (13.0 pcs/tree).

Continuing to study the influence of the 1-naphthaleneacetic acid on premature fruit drop in the Gala Mast variety, we note that lower values than in the control variant were recorded in the variants treated with NAA 15 ppm and NAA 30 ppm, where the final values were 4.0 pcs/tree.

In the case of the variants treated with NAA 22,5 ppm and NAA 15+22.5 ppm, the index in the study was 2.5 pcs/tree, and in the variants NAA 30 ppm and NAA 15+15 ppm, the number of fruits that fell to the ground under the crown of the tree was 2.0 pcs.

Higher values of the average weight of the fruits in the variants taken in the

study were registered within the apples that fell from the crown of the tree. For the Gala Mast variety, the given index was 159.5 -164.6 g.

The fruits that remained in the crown of the tree had a lower average weight compared to those that fell to the ground within and for the Gala Mast variety, the investigated index was 152.1 - 155.4 g.

Fruit production is the index for which fruit growers permanently choose to record high, constant values and competitive quality. The study shows that the total fruit production was in direct correlation between the total number of fruits and their average weight recorded during the research.

The total fruit production to the variety Gala Mast was 40.18 - 40.64 t/ha (Table 2). In the variants treated with the 1-naphthaleneacetic acid on both varieties, some legitimacy was not highlighted on the total fruit production per surface unit.

The study carried out further on the production of fruit from the crown of the tree and that which fell to the ground before the start of the harvesting process revealed a visible influence of the 1-naphthaleneacetic acid on the indices investigated.

Smaller productions of fruits registered in the crown of the tree at harvest was obtained in the control variant, without treatment in both varieties studied. If, for example, within the Gala Mast variety in the control variant the index in the study was 35.47 t/ha, then in the variants treated with the growth regulator Obsthormon 24a it was increasing and varied from 38.57 to 39, 84 t/ha, or an increase of 8.74 - 12.32% compared to the control variant.

Table 2

The influence of NAA treatment dose to the Gala Mast variety on premature fruit drop in the apple orchard

Variants	Production, t/ha			Share of fallen production, %
	fallen from the tree	left in the tree	total	
Control	40.42 a	35.47 c	4.95 a	12.25
NAA 15 ppm	40.33 a	38.57 b	1.76 b	4.64
NAA 22,5 ppm	40.64 a	39.66 a	0.98 c	2.41
NAA 30 ppm	40.64 a	39.84 a	0.80 c	1.97
NAA 37,5 ppm	40.28 a	38.53 b	1.75 b	4.34
NAA 15+15 ppm	40.18 a	39.52 a	0.66 c	1.64
NAA 15+22,5 ppm	40.42 a	39.45 a	0.97 c	2.40
LSD 0.05	1.147	0.875	0.310	-

Within the Gala Mast variety, the difference between the production registered in the control variant and the variants treated with the growth regulator is maintained only up to the variant treated with NAA 30 ppm.

Further increasing the dose up to 37.5 ppm recorded similar results to the variant NAA 15 ppm. The staggered treatment of the variants with the NAA also recorded values similar to the variants where the product administration dose was 22.5-30.0 ppm.

The production of fallen fruit from the crown of the trees depends on the amount of NAA administered per unit area. In the Gala Mast variety, this indicator decreases up to the NAA 30 ppm and in the staggered treated variants. The increase in the dose of the product to 37.5 ppm attracted a more massive fall of the fruits from the crown (4.34%).

The obtained results show that at the stage of treatment with 1-naphthaleneacetic acid, fruit firmness did not show essential differences, apart from the influence of the studied varieties (Table 3).

In the case of the Gala Mast variety, the firmness of the fruit pulp varied from 7.8 to 8.3 kg/cm^2. Lower pulp firmness values were recorded in the control variant, without treatment (8.3 kg/cm^2), compared to the variants treated with the 1-naphthaleneacetic acid (7.8-8.1 kg/cm^2), the difference being 0,3-0.5 kg/cm^2.

Table 3

The influence of NAA treatment dose to the Gala Mast variety on the fruit quality indices during the pre-harvest period in the apple orchard

Variants	Fruit firmness, kg/cm^2			Dry substance, %		Titratable acidity;%	
	On treatment	From the crown	Fallen from the crown	From the crown	Fallen from the tree	From the crown	Fallen from the crown
Control	9.6	8.3	7.0	14.2	15.7	0.30	0.26
NAA 15 ppm	9.6	8.1	7.0	14.3	15.8	0.29	0.26
NAA 22,5 ppm	9.5	8.0	6.8	14.4	15.9	0.29	0.25
NAA 30 ppm	9.7	8.0	6.8	14.6	15.9	0.27	0.24
NAA 37,5 ppm	9.6	7.8	6.6	14.6	16.1	0.26	0.24
NAA 15+15 ppm	9.6	8.1	6.9	14.2	15.9	0.29	0.25
NAA 15+22,5 ppm	9.7	8.0	7.0	14.3	15.8	0.29	0.26
LSD 0.05	0.234	0.185	0.168	0.226	0.224	0.014	0.011

A lower fruit firmness was recorded in the variant NAA 37.5 ppm (7.8 kg/cm^2) compared to the other treated variants (8.0-8.1 kg/cm^2). This is explained by the fact that ANA influences not only the hormonal disturbances that can occur within the trees, but in turn intensifies the production of ethylene, which is a precursor to fruit ripening.

In the case of the variants with staggered treatment with the 1-naphthaleneacetic acid in dose 15+15 ppm and 15+22,5 ppm, we note that pulp firmness is insignificantly lower compared to the variants with a single treatment based on 30 ppm and 37,5 ppm.

The treatment carried out with the 1-naphthaleneacetic acid in two rounds, i.e. staggered, recorded identical values as in the control variant (Gala Mast variety). Variants treated with higher doses of 1-naphthaleneacetic acid leave their mark on the degree of ripening of the fruits not only from the crown of the trees during the harvest period, but also those that have fallen to the ground.

Within the Gala Mast variety, the amount of dry matter accumulated by larger fruits was recorded in the variants NAA 30 ppm and NAA 37.5 ppm (14.6%)

while in the other variants, the studied index was identical, or slightly higher than in the control variant.

The staggered administration of the 1-naphthaleneacetic acid made it possible to make a greater amount of ANA available to the plants, to eliminate that hormonal imbalance that can be registered during the period until harvest and to obtain a rational co-ratio within the fruit between the dry substance and titratable acidity.

The study carried out over two years of research shows that the titratable acidity in fruits of the Gala Mast variety ranged from 0.26 to 0.30%. This legitimacy is also found in the case of fallen fruit, only the values obtained are much higher compared to the previous ones, constituting 0.24-0.26%.

There is a direct correlation between fruit dry matter content and titratable acidity. The higher the amount of dry matter in fruit decreases its titratable acidity. Increasing the dose of 1-naphthaleneacetic acid treatment resulted in a more intense ripening of the fruit and a decrease in its titratable acidity.

The amount of dry matter in the fruit fallen on the ground and the titratable acidity recorded constitute a more advanced degree of ripening of the fruit, which can then be used only for industrialization.

CONCLUSIONS

To prevent premature fruit drop, Gala varieties to must treat with NAA 30 ppm 15 days before harvest, or in two doses of 15 ppm. The first treatment must to do during the first decade of July and the second application 15 days before harvest.

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