

EFFECT OF PLANT GROWTH REGULATOR ON PREHARVEST FRUIT DROP ON THE GOLDEN REINDERS APPLE VARIETY

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ABSTRACT

The experimental plot is placed in the orchard "Dacfruct" Ltd. founded in 2006. The study subject of the experience was Golden Reinders apple variety grafted on M 9. The trees were trained as slender spindles. The distance of plantation is 3.5 x 1.2 m.

The research was conducted during the period of 2013 year. The aim of this study was to evaluate the effectiveness of grower regulator agent in reducing fruit drop et in Golden Reinders apple trees. The tested agents were Obsthormon 24a (NAA), which was sprayed in one time in preharvest period. During the research, it was studied the quantity of dropped fruits under the trees and percentage of total fruit yield.

It was established that, in the 2013 year, one treatment with Obsthormon 24a in dose of 500 ml/ha have a significant effect on fruit drop and fruit quality.

INTRODUCTION

'Golden delicious' and its clones was one of the most popular and commercially important apple cultivars in Moldova where it makes up about 20% of the national crop. Preharvest fruit drop can reduce production of apple cultivars in commercial orchards by as much as 30% (Marini et al., 1993; Yuan & Carbaugh, 2007. Losses resulting from preharvest fruit drop can be mitigated by applying either naphthaleneacetic acid (NAA) to delay drop.

Naphthaleneacetic acid (NAA) is an auxin-type growth regulator that primarily is used to reduce preharvest drop. NAA does not strengthen up the fruit attachment, but only prevents further loosening from the fruit stem. When it is used to reduce drop, it does not delay ripening Kvikliene et al., 2010; Schupp & Greene, 2004; Yuan & Li, 2008.

The aim of this study was to assess the effects of Obsthormon 24a (NAA) used during the preharvest period, on fruit drop and fruit quality.

MATERIAL AND METHODS

The researches were made during the period of 2013 year in the apple orchard founded in autumn 2006 at the company "Dacfruct" Ltd. with "knip boom" type apple trees crown formation. The study object of experience was Golden Reinders apple tree variety

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grafted on M9 rootstock. The crown was conducted on ameliorated thin spindle system. Distance of plantation is 3.5 x 1.2 m.

The chemical growth regulator used was Obsthormon 24a, containing 84 g/l active ingredient NAA, the preparation by the „L. Gobbi Ltd.” producer from Italy. To optimize the fruit dropping of the apple trees were experimented the following variants: V₁ - Control variant- without chemical treatments; V₂ - Obsthormon 24a - 400 ml/ha; V₃ - Obsthormon 24a - 500 ml/ha.

On experimental section in accordance with the experiences scheme in the second and in the third variants were made a single treatment (09/15/13) with a dose of 400 ml/ha and 500 ml/ha. Fruits drop was expressed as quantity dropped under the trees and percentage of total fruit yield.

RESULTS AND DISCUSSIONS

In the fall before collecting fruits, apple orchards register a premature dropping. Premature fruit dropping is registered when apple fruit are not harvested in the optimally set terms. To exclude this phenomenon, or reducing the amount of the fallen fruit, it is recommended to treat the trees with the fruit-based growth regulator NAA 10-20 days before harvest.

Investigations conducted demonstrated that during treatment (09/04/2013) the amount of fruit in the trees crown on apple variety Golden Reinders was 103-105 pcs (tab. 1). This amount of fruit in the trees crown is considered optimal to achieve consistent and qualitative annually productions. If in the control variant, the total amount of fruit from the tree crown was 104 units, then in the version treated with the growth regulator Obsthormon 24a ranged between 103-105 pcs/tree. A slight increase in the amount of fruit per tree was recorded from variant 3, where was planned the treatment with growth regulator Obsthormon 24a in dose of 500 ml/ha - 105 pcs/tree, compared to variant where was treated with Obsthormon 24a in dose of 400 ml/ha - 103 pcs/tree.

Table 1
The influence of growth regulator Obsthormon 24a on the quantity of fruits before and after treatment in the trees of the variety Golden Reinders, average fruit weight and diameter

Nr.	Variants	Quantity of fruits, pieces			The average weight, g	The average diameter, mm
		total per tree at treatment	on trees at harvest	dropped under the trees		
1.	Control, without treatment	104	86	18	167.0	72.0
2.	Obsthormon 24a, 400 ml/ha	103	98	5	168.0	72.3
3.	Obsthormon 24a, 500 ml/ha	105	102	3	167.8	72.2

This slight difference between variations in study 2 pcs /tree allowed us to mount the experiment for testing the growth regulator Obsthormon 24a to prevent premature fruit dropping in the fall before harvest. On the day of collection (09/15/2013) has been noticed that the amount of fruits in the trees crown in the variants in study was 86 to 102 pcs. A smaller amount of fruits in the crown of trees was recorded for control variant - without treatment, where the studied index is 86 pcs /tree.

In the variants treated with the growth regulator Obsthormon 24a, the amount of fruit in the crown of trees was 98-102 pcs. In the variant where is made the treatment with Obsthormon 24a in dose of 500 ml/ha were recorded maximal values 102 pcs/tree and in the variant treated with Obsthormon 24a in dose of 400 ml/ha - 98 pcs/tree. The difference between the amount of fruit in variant Obsthormon 24a in dose of 400 ml/ha and control variant-without treatment was 12 pcs/tree, and between the variant Obsthormon 24a in dose of 500 ml/ha and variant control -16 pcs/tree.

The most important index of apple plantation treatment with growth regulator to prevent fruit dropping is the amount of fruit fallen to the ground from the crown. The conducted investigations show that in variant control is recorded the largest amount of fruit fallen - 18 pcs/tree. The treatments with growth regulator Obsthormon 24a decreased essential premature fruit dropping until harvest. When the treatment with Obsthormon 24a was made in dose of 400 ml/ha amount of fallen fruit was 5 pcs and when the doses was 500 ml/ha was only 3 fruits.

Therefore, treating trees with growth regulator Obsthormon 24a improved physiological processes that occurred in plants, didn't allowed to form suber layer between stalk and fruit bearing formations and prevented their premature dropping.

The use of growth regulator Obsthormon 24a had the least influence on the weight and the average diameter of the fruit because on the ground fall the largest fruits which usually have an early maturity. The average fruit weight in variant control was 167.0 g and diameter was 72.0 mm. In the variant treated with Obsthormon 24a in dose of 400 ml/ha indexes studied were increased respectively by 6.0% and 4.2% and where the treatment with Obsthormon 24a was in dose of 500 ml/ha with 4.8% and 2 8%.

Studying the influence of treatment dose on the indicators investigated, recorded, an insignificant difference between variant Obsthormon 24a in dose of 400 ml/ha and the dose of 500 ml/ha. If in the variant Obsthormon 24a in dose 400 ml/ha amount of fruit prematurely fallen from trees crown was 5 pcs/tree, then in the variant Obsthormon 24a in dose of 500 ml/ha was 3 pcs/tree. The average diameter of the fruit weight was the same.

In apple orchards, the fruit production is one of the major index to the effectiveness of technological elements.

The conducted investigations (tabel 2) demonstrate that total fruit production in the variants studied was from 17.30 to 17.53 kg/tree. The results show that the treatment made with Obsthormon 24a growth regulator did not influence the total production registered per tree. If the productivity per tree in control variant was 17.36 kg, and the variants treated with Obsthormon 24a - 17.30 - 17.56 kg/tree, then it is confirmed by statistical analysis as between variants in the study there wasn't a significant difference.

Further studying the difference between production harvested from the tree and fallen on the ground, we record that a positive co-report records the variants treated with growth regulator Obsthormon 24a.

If in the control variant where no treatment was carried the production of fruits harvested from tree was 14.26 kg and the one collected from the ground was 3.10 kg, then the use of Obsthormon 24a had a positive influence on production remaining in trees crown.

The growth regulator Obsthormon 24a has naphthaleneacetic acid as an active ingredient which increases the amount of hormones formed in the plant. As a result of physiological changes that occur in the plant is delayed suber layer formation between fruit formation and fruit peduncle, which prevents their premature dropping.

When the treatment with growth regulator Obsthormon 24a was applied the fruit production being harvested from crown increased from 16.45 to 16.99 kg/tree and of the soil collected decreased recording values of 0.54 - 0.85 kg/tree. This difference between the

control, untreated and treated variants with Obsthormon growth regulator 24a is also confirmed by statistical data.

Studying the influence of growth regulator Obsthormon 24a depending on the used dose, we record a slight increase in the amount of fruit collected from the tree such as, in variant Obsthormon 24a in dose of 500 ml/ha - 16.99 kg compared with in the variant Obsthormon 24a in dose of 400 ml/ha - 16.45 kg, but statistical processing data do not show a significant difference between variants 2 and 3.

Table 2

The influence of growth regulators Obsthormon 24a on fruit production obtained from a tree of Golden Reinders apple variety on harvest

Nr.	Variants	Production, kg/tree			Share production fallen, %
		On the tree	Dropped from the tree	total	
1.	Control, without treatment	14.26	3.10	17.36	17.85
2.	Obsthormon 24a, 400 ml/ha	16.45	0.85	17.30	4.91
3.	Obsthormon 24a, 500 ml/ha	16.99	0.54	17.53	3.08
LSD 5%		0.60	0.17	0.67	-

The conducted investigations show that the largest share of fallen fruit was recorded in the control, untreated - 17.85%. On the next place with an essential difference is the variant Obsthormon 24a in dose of 400 ml/ha - 4.91% and then the variant Obsthormon 24a in dose of 500 ml/ ha - 3.08%.

Studying the fruit production per unit area, we record the index in study is closely correlated with the amount of trees per hectare and the productivity of a tree.

The data of table 3 shoes that growth regulator Obsthormon 24a did not influence the total production of fruits and was almost the same as in the control variant without treatment. In control variant fruit production was 39.68 t/ha, in the variant treated with Obsthormon 24a in dose 400 ml/ha - 39.54 t/ha and with Obsthormon 24a in dose of 500 ml/ha - 40.07 t/ha. It is obvious that from the amount of total production, some fell on the ground until the harvest, and the other was collected in the crown of trees. The ratio of the production amount collected from the ground and the one from crown of the tree is different and has been influenced by growth regulator Obsthormon 24a whose active ingredient is naphthaleneacetic acid.

In the control variant, the production collected from trees crown was 32.30 t/ha and harvested from the ground for industrialization 7.38 t/ha, or 22.8% of the share of quality.

The treatment with growth regulator Obsthormon 24a positively influenced on maintaining maximum production of apples in trees crown. When treating with Obsthormon 24a in dose of 400 ml/ha the production collected from crown was 37.52 t/ha and from the soil was 2.02 t/ha, which represented 5.3% of the share of quality. In the variant Obsthormon 24ain dose of 500 ml/ha the share of low quality production collected from the soil was 3.3% compared with that collected from the crown.

The effectiveness of treating with growth regulator Obsthormon 24a is demonstrated by the difference in production collected from the treated variants and the

version control without treatment. When treating with the growth regulator Obsthormon 24a in dose of 400 ml/ha, the difference between the production collected from the crown and the control variant was 5.22 t/ha and in the variant Obsthormon 24a in dose of 500 ml/ha increased, registering 6.49 t/ha.

Table 3

The influence of Obsthormon 24a growth regulators on fruit production obtained from a unit area of the variety Golden Reinders at harvest

Nr.	Variants	Production, t/ha			The difference between the production left and control
		total	dropped under the tree	in the tree	
1.	Control, without treatment	39.68	7.38	32.30	-
2.	Obsthormon 24a, 400 ml/ha	39.54	2.02	37.52	+5.22
3.	Obsthormon 24a, 500 ml/ha	40.07	1.28	38.79	+6.49
	LSD 5%	1.68	0.24	1.20	-

The obtained results show that between the variants where we use growth regulators to prevent fruit drop as Obsthormon 24a, more convincing results are obtained if the dose is 500 ml/ha, and there was a more favorable co-ratio between the amount of fruit collected from the crown and the sol.

In practice, it's a known fact that the new agro links developed should contribute not only to increase yield, but also to the quality (firmness, soluble dry substance, etc.), or at least not diminish it. For treating the winter varieties of apples with the growth regulator based on NAA, the recommended period is 10 -20 days before harvest. Basically, during this period the flesh firmness is 8.8 to 8.9 kg/cm².

The conducted investigations (tab. 4) demonstrate that apple fruit flesh firmness on Golden Reinders variety 10 days before harvest was 8.5 to 8.6 kg/cm². Basically, difference in the firmness of the flesh in that period wasn't recorded. In version control pulp firmness was 8.6 kg/cm², and in the variants where was expected treatment with growth regulator Obsthormon 24a was 8.5 to 8.6 kg/cm².

At the time of harvest (10 days after treatment) the Golden Reinders variety flesh firmness decreased to 7.1 to 7.7 kg/cm². The smallest firmness has been in variant control - 7.1 kg/cm².

When treating with growth regulator Obsthormon 24a, the pulp firmness was 7.5-7.7 kg/cm². This demonstrates that preparations based on naphthaleneacetic acid inhibits physiological processes of formation of ethylene and increases fruit firmness. These fruits can be stored in refrigerated rooms for a long period of time.

Dropped fruits on the ground have a much lower firmness compared to the fruits from the trees crown. The firmness of the fruit in the studied variants ranged from 6.0-6.4 kg/cm². So, the difference in firmness of fruit fallen on the ground and the ones collected from the trees crown was 1.1-1.3 kg/cm². The lowest value was recorded in the control variant - 1.1 kg/cm². Variants treated with growth regulator Obsthormon 24a showed a greater determination being 1.3 kg/cm².

The data obtained demonstrates that the amount of soluble dry substances on fruits of the trees at Golden Reinders variety was 12.6 to 13.1%.

The highest value of the weight soluble dry substance was obtained in the control, no treatment variant- 13.1%. When treating with Obsthormon 24a is noticed a decrease of 0.4-0.5% of the index in the study compared to the control variant, representing 12.6 to 12.7%. This demonstrates that Obsthormon 24a increased fruit firmness and decreased the amount of soluble solids.

Table 4

The influence of growth regulators Obsthormon 24 on firmness and soluble solids content of fruits of Golden Reinders apple variety

Nr.	Variants	Firmness, kg / cm ²			Soluble solids (% harvest)	
		at treatment	at harvest	dropped fruits	fruits of the tree	dropped fruits
1.	Control, without treatment	8.6	7.1	6.0	13.1	14.4
2.	Obsthormon 24a, 400 ml/ha	8.5	7.5	6.2	12.6	14.2
3.	Obsthormon 24a, 500 ml/ha	8.6	7.7	6.4	12.7	14.1

Dropped fruits on the ground have a smaller firm and a high content of soluble solids, representing the variations in the study from 14.1 to 14.4%. The amount of soluble solids demonstrates that fruit fell to the ground with a degree of maturation before, and can only be used for industrialization.

CONCLUSIONS

The treatments made with growth regulator based of NAA 10 days before harvesting decreased essentially the amount of dropped fruits.

The fruit firmness and soluble solids content recorded higher values in variants treated with Obsthormon 24a then in the control variant.

The smallest amount of dropped fruits at harvest was recorded in the variant Obsthormon 24a in dose of 500 ml/ha.

REFERENCES

- Kvikliene N., D. Kviklys and A. Sasnauskas, 2010, Effect of plant growth regulators on apple fruit preharvest drop and quality. *J. Fruit Ornament. Plant Res.* 18(2): 79-84.
- Marini, R. P., Byers R. E. and D. L. Sowers, 1993, Repeated applications of NAA control preharvest drop of 'Delicious' apples. *J. Hort. Sci. Biotech.* 68(2): 247-253.
- Schupp, J.R. and D.W. Greene, 2004, Effect of aminoethoxyvinylglycine (AVG) on preharvest drop, fruit quality, and maturation of 'McIntosh' apples. I. Concentration and timing of dilute applications of AVG. *HortScience* 39:1030-1035.
- Yuan R. and D. Carbaugh, 2007, Effects of NAA, AVG, and 1-MCP on ethylene biosynthesis, preharvest fruit drop, fruit maturity, and quality of 'Golden Supreme' and 'Golden Delicious' apples, *HortScience* 42(1): 101-105.
- Yuan, R. and J. Li, 2008, Effect of sprayable 1-MCP, AVG, and NAA on ethylene biosynthesis, preharvest fruit drop, fruit maturity, and quality of 'Delicious' apples. *HortScience* 43: 1454-1460.