EFFECTS OF GROWTH REGULATOR CERONE 480SL APPLICATION ON FRUIT COLOR DEVELOPMENT OF IDARED APPLE VARIETY

EFECTUL TRATĂRII CU REGULATORUL DE CREŞTERE CERONE 480SL ASUPRA COLORĂRII FRUCTELOR DE MĂR LA SOIUL IDARED

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Abstract. *The study subject of the experience was Idared apple variety grafted on M 9. The trees were trained as slender spindles. The distance of plantation is 3.5 x 1.2 m. To study color development of the apple fruits was experimented the following variants: 1. Control – no treatment; 2. Cerone 480SL - 1.3 L/ha; 3. Cerone 480SL - 1.5 L/ha. Growth regulator Cerone 480SL was sprayed one time, 2 – 3 weeks before commercial harvest. The research was conducted during the period of 2012 year. During the research, it was studied the firmness of fruits, hydrolysis and color index, etc. Color of fruits was estimated at harvest using a 5-point scale of grading. In the present research work, we demonstrated that Cerone 480SL may be included in the system of color development of Idared apple variety fruits, the dose of 1.3 L/ha, one spray applied, 2 – 3 weeks before commercial harvest.*
Key words: apple, growth regulator, firmness, color

Rezumat. *Ca obiect de studio a fost luat soiul de măr Idared altoit pe portaltoiul M9. Pomii au fost conduşi ca fus zvelt ameliorat. Distanța de plantare 3,5 x 1,2 m. Pentru colorarea fructelor de măr au fost montate următoarele variante: 1. Martor - fără tratare; 2. Cerone 480SL - 1,3 L/ha; 3. Cerone 480SL - 1,5 L/ha. Regulatorul de creştere Cerone 480SL a fost aplicat o singură dată cu 2 – 3 înainte de de recoltare. Cercetările au fost efectuate pe parcursul anului 2012. Pe parcursul cercetărilor sa studiat fermitatea fructelor, indicei de hidroliză şi de colorare, etc. Colorarea fructelor a fost determinată în Perioada recoltării după o scară cu 5 gradații. Cercetările, au demonstrat, că Cerone 480SL poate fi inclus în sistemul tehnologic în doza de 1,3 L/ha pentru ameliorarea culorii la soiul Idared aplicat o singură dată cu 2 – 3 săptămâni înainte de recoltare.*
Cuvinte cheie: măr, regulator de creştere, fermitate, culoare.

INTRODUCTION

At the moment, the customers prefer apples of yellow, green and red color. However, for a more intense coloration, it is necessary to implement new management techniques to improve quality. Getting a more intense and uniform staining, currently remains one of the unsolved problems until the end of fruit

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producers (Babuc *et al.,* 2013).

The apple color depends on the anthocyanin share, which are determined by the environment and exogenous regulators that influence the accumulation of anthocyanin (Burzo *et al.,* 1999; Curry, 1997; Larrigaudiere *et al.,* 1996; Yang, 1985). In last years, in different countries, to enhance color the fruit is used the growth regulator whose active ingredient is ethylene (Looney, 2004).

The scientific news of the obtained results is that for the first time in Republic Moldova is trying to recommend for use growth regulator Cerone 480SL to the color development of Idared apple variety.

MATERIAL AND METHOD

The research was conducted during 2012 year in apple orchard founded in the autumn of 2009 at the company „Codru-ST" Ltd. The subject of the experience was Idared apple variety grafted on M9 rootstock. The trees were as sleander spindle. The distance plantation is 3.5 x 1.2 m.

To study influence of ethephon to the color development of Idared apple variety fruits were experimented the following variants of treatment: 1. Control – no treatment; 2. Cerone 480SL-1.3 L/ha; 3. Cerone 480SL-1.5 lLha.

The treatment was made with portable sprayer in the early morning hours without wind. The quantity of solution per tree was 0.5-0.6 liters considering the amount of trees per unit area and the quantity of water needed which is 1500 L/ha.

The soil was kept as grass silage on the intervals between rows and field sprayer on strips between the trees rows with the width of 1.2 m.

Location of plots was made into blocks, each variant having four repetitions. Each repetition has 7 trees. At the border between the repetitions and experimental plots were left one untreated tree to avoid the duplication of variants or repetitions while performing treatments.

The evaluation was performed using apple firmness penetrometer FT 327, which secures ingress resistance of pulp a piston area of 1 cm^2.

Hydrolysis index was established using iodine test. The fruits were compared with the diagram 10 drawn gradation conversion of starch elaborated to Ctifl collaborators (France).

The degree of acetylene emanation was established with ethylene analyzer ICA 56. The color intensity of fruit area was determined by the method described by Alina Basak a 5-point scale. First gradation fruits colored from 1 - 25%, second – 26 - 50%, third – 51 - 75%, fourth – 76 - 90% and fifth – 90% or more from the fruit surface.

The chemical composition of the fruit was assessed by the content of soluble solids and titratable acidity.

RESULTS AND DISCUSSIONS

Fruits that are picked late have low pulp firmness and are not resistant when handling, they fall before picking and it worsens the palatability and technological qualities.

To establish the optimal timing of harvest were used different methods: by starch content, pulp resistance on penetration, comparing the color of the fruit

with colored strips standard, the number of days between the end of flowering and harvesting, the average weight of a fruit, the total acidity, the content of soluble substances, etc.

The data from conducted investigations (tab. 1) demonstrates that the fruit pulp firmness after the treatment with the growth regulator Cerone 408 SL made on 05.09.12 was the same on all the studied variants being 9.6-9.7 kg/cm^2.

At 20 days after treating with the growth regulator Cerone 480 SL was registered a decrease in the fruit pulp firmness. In the control variant were no treatment was made the fruit pulp firmness was 8.0 kg/cm^2, or a decrease by 1.7kg/cm^2 compared with the previous measurement.

When the treatment was made with Cerone 480 SL in dose of 1.3 and 1.5L/ha, the fruit pulp firmness decreases being 7.7 kg/cm^2 which means it decreased with 0.3 kg/cm^2 compared with the control variant.

The obtained results demonstrate that the treatments made with the growth regulator Cerone 480 SL influenced on fruit pulp firmness. The changes in the treatment dose from 1.3 L/ha to 1.5 L/ha, it didn't influence on the fruit pulp firmness being 7.7 kg/cm^2.

Table 1

Growth regulator Cerone 480 SL influence on fruit ripening index on Idared apple variety

Variants	Firmness, kg/cm^2		Index of Hydrolysis	The amount of ethylene emanating, µL/kg/h
	At treatment	20 days after treatment		
Control	9.7	8.0	4.5	0.013
Cerone 480SL, 1.3 L/ha	9.7	7.7	5.0	0.015
Cerone 480 SL, 1.5 L/ha	9.6	7.7	5.0	0.016
DL 5%	0.34	0.29	-	-

During the fruit maturity phase occurs the process of change the starch hydrolysis into monosaccharide thus decreases their quantity. This can be registered by applying the iodine test. If the cross-section is less colorful, it means that the fruit contains less starch which shows a progression of ripening fruit.

The conducted study demonstrates that the hydrolysis index in the studied variants was 4.5-5.0. The lowest hydrolysis index was 4.5 in the control variant where no treatments with the growth regulators were made.

Treatments made with the growth regulator Cerone 480 SL influenced on the fruits ripening. In the variant where the treatment with Cerone 480 SL was made in dose of 1.3 L/ha, the hydrolysis index was 4.5 or it increased with 0.5 compared with the control variant. This is also valid and in the variant where the treatment with the growth regulator Cerone 480 SL was made in dose of 1.5 L/ha.

This demonstrates that according to the hydrolysis index in the variants

where treatment was made with Cerone 480, the fruits could be picked for a longer storage period.

Ethylene is considered as the main fruit ripening hormone. This substance is biosynthesize in all plant organs and in greater quantity in climatic fruits (apples).

In order to study the intensity of fruit ripening and the influence of the growth regulator who has as base ethephon on maturity and fruit coloration, we studied the amount of ethylene emanated in a certain period of time.

The quantity of ethylene emanated after harvest is different in the studied variants. The lowest amount of ethylene emanated was registered in the control variant without treatment being 0.013 µL/kg/h.

The use of the growth regulator Cerone 480 SL increased the quantity of ethylene emanated being 0.015-0.016 µL/kg/h. This demonstrates that the use of Cerone 480 SL intensified fruit maturation and increased by 0.002–0.003µL/kg/h the quantity of ethylene emanated. The increase in dosage of Cerone 480 SL from 1.3 L/ha to 1.5 L/ha did not influence the studied index.

This study demonstrates that the use of the growth regulator Cerone 480 SL influenced on the fruit pulp firmness, on the index of hydrolysis and on the quantity of ethylene emanated in the fruits after harvest compared to the control variant.

The content of soluble substances is a feature of the variety and after the index value can determine the optimal harvest time. As we get closer to harvest time, the intensity of accumulation of soluble dry substances decreases.

The conducted research demonstrated that the amount of soluble dry substance on Idared variety in the studied variants was 13.7-14.3% (tab. 2).

The lowest value of the share of soluble dry substance was obtained in version control being 13.7%. When the growth regulator was used, it was noticed an increase of the studied index up to 14.2-14.3%. Therefore, treating with Cerone 480 SL intensified the fruit maturity and respectively it increased the quantity of soluble dry substance in fruits with 0.6-0.7% compared with control variant.

Table 2

The influence of the growth regulator Cerone 480 SL on biochemical and coloring indexes in apple fruit of Idared variety

Variants	Soluble dry substance, %	Titratable acids, %	Coloration index	The share of fruits picked in the first harvest, %
Control	13.7	0.66	3.1	56.7
Cerone 480 SL, 1.3 l/ha	14.2	0.60	4.3	85.3
Cerone 480 SL, 1.5 l/ha	14.3	0.59	4.5	86.8

The share of fruit titratable acid is in a direct dependence on the amount of soluble substances. As the amount of soluble dry substance decreases, the fruit

titratable acid increases recording the highest value in the control variant - 0.66%.

The treatments with the growth regulator Cerone 480 SL decreased the share of titratable acid. When the treatments with Cerone 480 SL were made in dose of 1.3 L/ha, the share of titratable acids was 0.60 %, and when the dose increased to 1.5 L/ha, the studied index decreased to 0.59%.

The conducted research proves that the lowest index of coloration was registered in the control variant being 3.1.

The treatments made with the growth regulator Cerone 480 SL intensified the coloration index. When treatments were made with Cerone 480 SL in dose of 1.3 L/ha, the coloration index improved and was 4.3. The most colorful fruits registered in the variant where the treatment with the growth regulator Cerone 480 SL was made in dose of 1.5 L/ha and the studied index was 4.5.

The most eloquent index is the share of fruits on the first harvest. The investigations conducted demonstrate that in the control variant on the first harvest were picked 56.7% of the fruits from the trees crown.

The treatments made with Cerone 480 SL whose active ingredient is ethephon increased the share of fruits picked in the first harvest. When the treatment with Cerone 480 SL was made in dose of 1.3 L/ha, from the tree crown were picked 85.3% of fruits, as the dose increased to 1.5 L/ha, the studied index increased being 86.8%.

The conducted investigations demonstrate that the same results of the coloration index and the share of picked fruits on the first harvest was obtained when the trees were treated with the growth regulator Cerone 480 SL in dose of 1.3 L/ha and in dose of 1.5 L/ha.

In the control variant, the sales revenue was 129.0 k lei/ha, but when treatments were made with the growth regulator Cerone 480 SL increased the sales revenue being respectively 137.0 and 141.0 k lei/ha. In the treated variants, the highest sales revenue was registered in the variant were the treatment was made in dose of 1.5 L/ha being 141 k lei/ha (tab. 3).

Table 3

Economic efficiency of production on Idared variety using the growth regulator Cerone 480 SL

Variants	Sales revenue, k lei/ha	Investments to buy the product, k lei/ha	Production cost, k lei/ha	Profit, k lei/ha	level of profitability, %
Control	129.0	-	70.0	59.0	84.3
Cerone 480 SL, 1.3 L/ha	137.0	0.44	68.9	68.1	99.8
Cerone 480 SL, 1.5 L/ha	141.0	0.50	71.0	70.0	98,6

The treatments made with the growth regulator Cerone 480 SL did not influence on the production cost because the investments made to buy the Cerone

480 SL in dose of 1.3 L/ha and 1.5 L/ha were respectively 0.44 and 0.50 lei/ha.

The lowest production cost registered in the variant treated with Cerone 480 SL in dose of 1.3 L/ha being 68.9 lei/ha. In the variant where treatment with Cerone 480 SL was made in dose of 1.5 L/ha the production cost was 71.0 k lei/ha, while in the control variant was 70.0 k lei/ha. This slight increase was recorded due to the additional costs resulted from fruits harvesting.

Profit is in direct correlation with the sale revenue and production cost. The lowest profit registered in the control variant being 59.0 k lei/ha and the highest profit was registered in the variant treated with Cerone 480 SL in dose of 1.5 L/ha being 70.0 k lei/ha. When the treatment with Cerone 480 SL was made in dose of 1.3 L/ha the profit was with 9.1 k lei/ha more than in the control variant and with 1.9 k lei/ha lower than in the variant Cerone 480 SL in dose of 1.5 L/ha.

The benefit of treating with the growth regulator Cerone 480 SL is proven and with the level of profitability. If in the control variant the level of profitability was 84.3% then in the variant treated with Cerone 480 SL in dose of 1.3 L/ha this index increased by 99.8% and in the variant treated with Cerone 480 SL in dose 1.5 L/ha, the mentioned index decreased with 1.2% compared with the previous variant, but with 14.3% higher compared with the control variant.

The results of the economic efficiency of fruit production demonstrates that for Idared variety whose repining period is during winter the highest values were registered in the variant treated with the growth regulator Cerone 480 SL in dose of 1.3 L/ha.

CONCLUSIONS

1. The efficacy of the growth regulator Cerone 480 SL in optimizing fruit ripening and coloring influenced the share of colorful fruit production compared to the control.

2. According to the experimental results the growth regulator Cerone 480 SL can be included in apple cultivation technological system in dose 1.3 L/ha applied once with 2-3 weeks before harvest to optimize the fruit maturity and coloration on winter apple variety.

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