THE INFLUENCE OF DIFFERENT FRUIT THINNING PRODUCTS ON PRODUCTIVITY AND QUALITY OF 'FUJI KIKU' VARIETY

INFLUENȚA DIFERITOR PRODUSE DE RĂRIRE A FRUCTELOR ASUPRA PRODUCTIVITĂȚII ŞI CALITĂȚII LA SOIUL 'FUJI KIKU'

PESTEANU Ananie*[1]
*Corresponding author e-mail: a.pesteanu@uasm.md

Abstract. *The study subject was Fuji Kiku apple variety grafted on M9. To study thinning of apple fruits were experimented the following variants: 1. Control – without treatment; 2. Manual thinning; 3. Ger ATS LG, 12 L/ha; 4. Geramid New, 1,5 L/ha; 5. Dirager, 0,3 L/ha; 6. Goltex 700SC, 3,5 L/ha; 7. Dira Max LG, 2,5 L/ha; 8. Gerba 4 LG, 2,5 L/ha. It was established that, the good effect of thinning was after application with Ger ATS LG, 12 L/ha. In the case of no favorable conditions during the previous treatment, must to utilize Goltex 700SC, 3.5 L/ha, Dira Max LG, 2.50 L/ha and Gerba 4 LG in the dose 2.5 L/ha, when the size of the central flower of the inflorescence has a diameter of 10-15 mm. It not recommended for the Fuji Kiku variety to spray with NAD (Geramid New) and ANA (Dirager), because formed a large "pygmy" fruits.*
Key words: apple, growth regulator, thinning, yield, quality

Rezumat. *Obiect a studiului a fost soiul Fuji Kiku altoit pe M9. Pentru studia diferitor produse de răririe a fructelor s-au experimentat următoarele variante: 1. Martor - fără tratament; 2. Răririe manuală; 3. Ger ATS LG, 12 L/ha; 4. Geramid Nou, 1,5 L/ha; 5. Dirager, 0,3 l/ha; 6. Goltex 700SC, 3,5 L/ha; 7. Dira Max LG, 2,5 L/ha; 8. Gerba 4 LG, 2,5 L/ha. S-a stabilit că răririe eficace a fost înregistrată la tratarea cu Ger ATS LG, 12 L/ha. Când nu sunt condiții favorabile în timpul tratamentului anterior, de utilizat Goltex 700SC, 3,5 L/ha, Dira Max LG, 2,50 L/ha şi Gerba 4 LG în doza de 2,5 L/ha, când diametrul fructului central în inflorescență este de 10-15 mm. Nu se recomandă de tratat soiul Fuji Kiku cu produse pe bază de NAD (Geramid New) şi ANA (Dirager), deoarece se formează un număr mare de fructe „pygmy".*
Cuvinte cheie: măr, regulator de creştere, răririe, recoltă, calitate

INTRODUCTION

Large, high quality fruit production can be obtained only by implementing modern technologies in accordance with the natural, economic conditions, specific to each field sector of the enterprises (Babuc *et al.* 2013).

The normalization of the load fruit organs is the technological operation through which the fruit load is regulated in order to obtain the highest possible production constantly year by year and high quality (Peşteanu and Calestru, 2017).

Currently, a lot of apple varieties set a large amount of fruits. In order to

[1]State Agrarian University of Moldova, Chisinau, Republic of Moldova

normalized the amount of load fruit organs in apple trees, it is necessary to act on newly formed flowers and fruits by manual or chemical thinning (Balan and Vămă;escu, 2011; Basak, 2004; Cimpoieş, 2012; Vămăşescu, 2012).

Currently, for chemical thinning use products whose active ingredients are: NAD, ANA, 6-Benzyladenine, Metamitron, etc., or different combinations of these products: ANA + BA, Etefon + ANA, Etefon + BA etc. (Basak, 2004; Brunner, 2014; Gabardo *et al.* 2017; Peşteanu and Calestru, 2020; Stopar, 2006).

The amount of applications of growth regulators, as well as the terms of treatment, depending on the type of preparation used or their combination, variety, area, age of trees, climatic conditions, etc. (Babuc *et al.* 2013; Peşteanu, 2015).

MATERIAL AND METHOD

The research was carried out in the apple orchard of "Domulterra" LLC. The planting was carried out in the spring of 2013, with "Knip baum" type trees. During 2016, was studied the influence of different growth regulators on the Fuji Kiku variety grafted on the M9 rootstock. The planting distance is 3.5x0.8 m.

In accordance with the endowment growth regulators intended for the chemical thinning of fruits, the following scheme of spray was elaborated (tab. 1).

Table 1

The scheme of experiments on the normalization of the load of fruit organs by using different products and thinning methods for Fuji Kiku apple trees

Variants	Active ingredient	Application method
Without thinning, (control)	-	-
Manual thinning	-	Manual thinning of the fruits was performed when the fruits were 1.5-2.0 cm in diameter.
Ger ATS LG, 12 L/ha	N 12%, SO_3 65%	By spraying, when the central flowers on the perennial wood bloomed + 2-3 days.
Geramid New, 1,5 L/ha	NAD (40g/L)	By spraying, when the fall of 80% of the petals occurred, + 2-3 days
Dirager, 0,3 l/ha	ANA (37g/L)	By spraying, when the diameter of the central fruit in the inflorescence is 8-9 mm.
Goltex 700SC, 3,5 L/ha	Metamitron, 350 mg/L	When the diameter of the central fruit in the inflorescence is 10-12 mm.
Dira Max LG, 2,5 L/ha	6BA (41g/L) ANA (4,1g/L)	By spraying, when the diameter of the central fruit in the inflorescence is 10-15 mm.
Gerba 4 LG, 2,5 L/ha	6BA (41g/L)	By spraying, when the diameter of the central fruit in the inflorescence is 10-15 mm.

The research was performed in the field and laboratory conditions according to the accepted method of carrying out experiments on fruit crops with growth regulators.

RESULTS AND DISCUSSIONS

The investigations carried out during the rest period (tab. 2) show us that the Fuji Kiku variety trees differentiated a sufficient amount of fruit buds, which when the trees bloomed in spring formed 218-227 inflorescences. This constitutes 1090-1135 flowers, which as a result of a favorable pollination allow obtaining constant fruit harvests.

The whole range of products used to regulate the fruit load can be divided into 2 groups according to the amount of inflorescences tied in the crown of the trees. The first group includes Geramid New and Dirager products, and the second group includes Ger ATS LG, Goltex 700SC, Dira Max LG and Gerba 4 LG.

In the manual thinning version, all the fruits are placed one by one in the inflorescence and obtaining a higher quality production both from an organoleptic and biochemical point of view.

Lower values were recorded in the variants treated with Geramid New growth regulator at a dose of 1.5 L/ha and Dirager at a dose of 0.3 L/ha.

When using the Dira Max LG growth regulator at a dose of 2.5 L/ha, the share of one fruit in one inflorescence was 88.5%, of two fruits 10.3% and only 1.2% of the inflorescences formed three fruits each.

The most rational location of the fruits in an inflorescence with chemical thinning was registered in the variant where the Goltex 700SC product was used in the dose of 3.5 L/ha, where 94.4% of the fruits were one in the inflorescence, and 5.6% two fruits in inflorescence.

Table 2

The amount of total inflorescences (ATI), set (ASI) in the crown of Fuji Kiku apple trees and the share of fruits in an inflorescence according to the growth regulators used to thin the reproductive organs, 2016

Variants	ATI, pcs/tree	ASI, pcs/tree	The share of fruits in an inflorescence, %			
			1 pcs	2 pcs	3 pcs	4 pcs
Without thinning, (control)	220	100	36.0	30.0	20.0	14.0
Manual thinning	223	79	100.0	-	-	-
Ger ATS LG, 12 L/ha	218	90	81.1	13.3	5.6	-
Geramid New, 1.5 L/ha	221	76	65.8	19.7	13.1	1.4
Dirager, 0.3 L/ha	225	72	68.0	15.3	13.9	2.8
Goltex 700SC, 3.5 L/ha	218	89	94.4	5.6	-	-
Dira Max LG, 2.5 L/ha	227	87	88.5	10.3	1.2	-
Gerba 4 LG, 2.5 L/ha	224	84	92.8	7.1	-	-

Significantly lower values were recorded in the variant where the trees were treated with the Gerba 4 LG growth regulator at a dose of 2.5 L/ha.

The amount of fruits differs depending on the variants studied. The

highest amount of fruits was recorded in the control version, without thinning, where the index under study was 245 pcs/tree.

In the variant with manual thinning and the variants with chemical thinning of the fruits, an essential decrease of the quantity of fruits in the crown of the trees was registered, varying from 79 to 114 pcs. This shows us that different products intended for the normalization of the reproductive organs differently influenced the amount of fruits in the crown of the trees (tab. 3).

The amount of fruits left in the crown of the tree at manual thinning was determined by the cross-sectional area of the trunk and the fruiting capacity of the Fuji Kiku variety and constituted 7 pcs/cm^2 of SSTT. In this variant, the amount of fruits was 79 pcs/tree, or 3.2 times less, compared to the control variant.

In the case of treating the trees with Gerba 4 LG products at a dose of 2.5L/ha, Goltex 700SC at a dose of 3.5 l/ha and Dira Max at a dose of 2.5 L/ha, the amount of fruits in the crown of the trees constituted, respectively 90; 94 and 98 pcs/tree.

Variants treated with Dirager growth regulators at a dose of 0.3 L/ha, Geramid New at a dose of 1.5 L/ha and foliar fertilizer Ger ATS LG at a dose of 12.0 L/ha, the amount of fruits increased compared to the previous variants with chemical thinning, registering, respectively, 109; 114 and 112 pcs/tree.

Table 3

The influence of the growth regulator on the thinning of the reproductive organs on the fruit production in the crown of Fuji Kiku apple trees, 2016

Variants	The number of fruits, pcs/tree	Average weight, g	Fruit production		In % compared to control variant
			kg/tree	t/ha	
Without thinning, (control)	252	87.5	22.05	78,74	100.6
Manual thinning	79	178.4	14.09	50.31	63.8
Ger ATS LG, 12 L/ha	112	164.7	18.44	65.85	83.6
Geramid New, 1.5 L/ha	114	134.3	15.31	54.67	69.4
Dirager, 0.3 L/ha	109	130.7	14.25	50.88	64.6
Goltex 700SC, 3.5 L/ha	94	168.8	15.86	56.63	71.9
Dira Max LG, 2.5 L/ha	98	167.7	16.43	58.67	74.5
Gerba 4 LG, 2.5 L/ha	90	170.1	15.31	54.67	69.4
LDS 5%	8.7	7.7	1.03	2.87	-

Lower values of the average weight of a fruit were recorded in the control variant, where the mentioned index was 87.5 g. On the other variants studied only when using Geramid New growth regulators at a dose of 1.5 L/ha and Dirager in dose 0.3 L/ha, the average weight of a fruit was less than 150 g and amounted to 134.3 and 130.7 g, respectively. This decrease in the average weight of fruit in the Fuji Kiku variety was due to the fruit "pygmy" who was obtained as a result of treatment with products based on NAD and ANA meaning there was a blockage of fruit development.

On the other variants, the average weight of the fruits registered higher values constituting 164.7 - 178.4 g.

The obtained results show us that the use of products for the normalization of the reproductive organs increased by 188.2-194.4% the average weight of the fruits compared to the control variant.

Higher fruit productions per tree and per unit area were registered in the control variant, without thinning where the mentioned indexes constituted respectively 22.05 kg/tree and 78.74 t/ha. Next, the variant treated with the foliar fertilizer Ger ATS LG in the dose of 12.0 L/ha is placed in decrease, where the fruit production registered, respectively 18.44 kg/tree and 65.85 t/ha.

In the case of the manual thinning variant, the productivity of a tree constituted 14.09 kg, and at a surface unit 50.31 t/ha/was obtained, or a decrease by 56.5% compared to the control variant. Productions, identical as in the manual thinning variant, were also registered in the variant treated with the Dirager growth regulator at a dose of 0.3 l/ha, where it constituted - 50.88 t/ha.

In the other variants treated with Geramid New products, 1.5 L/ha; Gerba 4LG, 2.5 L/ha; Goltex 700SC, 3.5 L/ha and Dira Max LG, 2.5 L/ha, the fruit production was higher than 50 t/ha and constituted 54.67 respectively; 54.67; 56.63 and 58.67 t/ha.

In the case of the control variant, without thinning, the fruits that are attributed to category I of quality constituted 23.4%, to category II of quality - 33.4%, and the others were unconditioned (tab. 4).

Table 4

The influence of the method of thinning the reproductive organs on the redistribution of fruits according to their diameter in apple trees of the Fuji Kiku variety, 2016

Variants	The share of fruits (%) based on their diameter (mm)							Average diameter, mm
	>55	56-60	61-65	66-70	71-75	76-80	<80	
Without thinning, (control)	12.4	30.8	33.4	23.4	-	-	-	53.8
Manual thinning	-	-	-	4.7	20.3	28.7	46.3	78.4
Ger ATS LG, 12 L/ha	-	-	5.7	10.4	30.0	28.4	27.5	73.7
Geramid New, 1.5 L/ha	2.7	4.2	14.3	16.4	30.1	32.3	-	71.4
Dirager, 0.3 L/ha	1.0	2.4	16.7	18.1	29.0	32.8	-	71.7
Goltex 700SC, 3.5 L/ha	-	-	3.7	7.3	26.1	30.7	32.1	75.1
Dira Max LG, 2.5 L/ha	-	-	4.6	8.7	27.7	29.0	30.0	75.6
Gerba 4 LG, 2.5 L/ha	-	-	2.1	5.8	25.7	32.1	34.3	76.0

The variants treated with Goltex 700SC products at a dose of 3.5 L/ha and Dira Max LG in the amount of 2.5 L/ha registered insignificantly lower values compared to the manual thinning variant.

Variants where manual thinning and chemical thinning were performed with Ger ATS LG at a dose of 12.0 L/ha, Goltex 700SC at a dose of 3.5 L/ha, Dira Max at a dose of 2.5 L/ha and Gerba 4 LG at a dose 2.5 L/ha most fruits are assigned to category I and extra quality. Only in the variants treated with Dirager in the dose of 0.3 L/ha and Geramid New in the dose of 1.5 L/ha, a higher percentage of fruits is attributed to those with a diameter of less than 61-65 mm.

CONCLUSIONS

1. To normalize the load of apple fruits, the treatment of Fuji Kiku trees needs to be carried out with the foliar fertilizer Ger ATS LG in a dose of 12.0 L/ha, applied by the spraying method, when the central flowers on the wood older than two years of flowering plus 2-3 days.

2. If, during the previous treatment, there were no favorable conditions to spray with the foliar fertilizer Ger ATS LG , the treatment can be performed with Goltex 700SC products in a dose of 3.5 L/ha, Dira Max LG in a dose of 2.50 L/ha and Gerba 4 LG at a dose of 2.5 L/ha, when the size of the central fruit in the inflorescence is 10 - 15 mm in diameter. Since 2018, the product Brevis is registered in the Republic of Moldova, whose active ingredient is metamitron.

3. It is not recommended for Fuji Kiku variety to use growth regulators based on NAD (Geramid New) and ANA (Dirager), as a large amount of "pygmy" type fruits is formed.

REFERENCES

1. **Babuc V., Peşteanu A. Gudumac E., Cumpanici A., 2013** - *Producerea merelor.* Chişinău, 240 p.
2. **Balan V., Vămăşescu S., 2011** - *Increase quantity and quality of apple fruit by normalization of load by different methods of thinning.* Lucrari ştiinţifice Seria B- LV. UŞAMV. Bucureşti, Seria Hortcultură, p. 352 - 357.
3. **Basak A., 2004** - Fruit thinning by Using Benzyladenine (BA) with Ethephon, ATS, NAA, Urea and Carbaryl in Some Apple Cultivars. Acta hort. 653, p. 99-106.
4. **Brunner P., 2014** - Impact of metamitron as a thinning compound on apple plants. Acta Hort. 1042, p. 173-181.
5. **Gabardo G. C., Petri J. L., Hawerroth F. J., Couto M. et al., 2017** - *Use of Metamitron as an apple thinner.* Rev. Bras. Frutic. vol. 39, no. 3, p. 1-9.
6. **Cimpoieş Gh., 2012** - *Cultura mărului.* Chişinau, Editura „Bons Offices", 380 p.
7. **Peşteanu A., 2015** - *The influence of thinning agent on base of 6-BA and NAA on productivity and fruit quality of "Gala Must" variety.* In: Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, vol. 72(1), Horticulture, p. 151-156.
8. **Peşteanu A., Calestru O., 2017** - *Reglarea încărcăturii de rod la pomii de măr de soiul Golden Reinders prin diverse metode de rărire.* In: Ştiinţe Agricole. nr. 2, p. 37-42.
9. **Peşteanu A., Calestru O., 2020** - *Eficacitatea normării încărcăturii de rod la unele soiuri de măr în perioada precoce de dezvoltare a organelor reproductive.* In: Ştiinţe Agricole. nr. 1, p. 46-54.
10. **Stopar M., 2006** - *Thinning of "Fuji" apple trees with Ethephon, NAD and BA, alone and in combination.* Journal of Fruit and Ornamental Plant. vol. 14, p. 39-45.
11. **Vămăşescu S., 2012** - *Apple harvest based on the variety and the fruit thinning method system.* Annals of the University of Craiova. vol. XVII (LIII), p. 437 – 442.