

## INFLUENCE OF FERTILIZATION WITH ZINC PRODUCTS ON THE PRODUCTIVITY AND QUALITY OF APPLE FRUITS

### EFFECTUL TRATĂRII CU FERTILIZANȚI FOLIARI PE BAZĂ DE ZINC ASUPRA PRODUCTIVITĂȚII ȘI CALITĂȚII FRUCTELOR DE MĂR

PESTEANU A.<sup>1</sup>, CROITOR A.<sup>1</sup>

e-mail: a.pesteanu@uasvm.md

**Abstract.** *The study subject of the experience was Idared apple variety grafted on M 9, trees were trained as Slender Spindles for distance 3.5 x 0.8 m. To study the influence of fertilization with zinc products on the fructification of apple plantation was experimented the following variants: 1. Control – no treatment; 2. Basfoliar Flo Zn - 1.0 L/ha; 3. Nertus Zinc - 2.0 L/ha; 4. Nertus Zinc - 3.0 L/ha. The Basfoliar Flo Zn fertilizer was applied once by spraying in the intensive growth phase of the fruit. The first treatment with Nertus Zinc was given in the pink button phase, the second - after flowering, and the third - the intensive growth of the fruits. The research was conducted during the period of 2015 year. In the present research work, we demonstrated that Nertus Zinc may be included in the technology system, applied 3 sprays at 2.0 L/ha.*

**Key words:** apple, foliar fertilizer, production, color.

**Rezumat.** *Ca obiect de studiu a fost luat soiul de măr Idared altoit pe portaltoiul M9, pomii au fost conduși ca fus zvelt ameliorat, distanța de plantare 3,5 x 0,8 m. Pentru a studia influența fertilizării cu produse pe bază de zinc asupra fructificării plantației de măr au fost montate următoarele variante: 1. Martor - fără tratare; Basfoliar Flo Zn – 1,0 L/ha; 3. Nertus Zinc – 2,0L/ha;4. Nertus Zinc – 3,0 L/ha. Fertilizantul Basfoliar Flo Zn a fost aplicat o singură dată, în faza de creștere intensivă a fructelor. Primul tratament cu Nertus Zinc a fost administrat în faza butonul roz, al II-lea – după înflorire, iar al III-lea – în faza creșterea intensivă a fructelor. Cercetările au fost efectuate pe parcursul anului 2015. Cercetările, au demonstrat, că Nertus Zinc poate fi inclus în sistemul tehnologic aplicat în 3 etape în doza de 2,0 L/ha.*

**Cuvinte cheie:** măr, fertilizant foliar, producție, culoare.

## INTRODUCTION

Foliar fertilization is an agro technical procedure that complements, without replacing the root fertilization. It consists of spraying branches, shoots and leaves with different solutions of liquid fertilizers (Babuc, 2012; Babuc *et al.*, 2013; Ghena *et al.*, 2004).

Foliar fertilization allows for rapid compensation of deficient items and it is easy to apply and in some cases can be used with some phytosanitary products (Cimpoieș, 2012; Orphanas, 1982).

---

<sup>1</sup>State Agricultural University of Moldova, Chișinău, Republic of Moldova

Most often, the zinc deficiency occurs in the apple and occurs primarily on soils with high pH and with a large reserve of Ca; with humidity excess and low temperatures (Swietlik, 2002; Toma, 2008).

The absorption of zinc by trees corresponds to the pink button period, the intensive growth of shoots and the formation of fruits, and then decreases towards the end of the summer (Cimpoieș, 2012; Voiculescu *et al.*, 2005).

## MATERIAL AND METHOD

The research was conducted during 2015 year in apple orchard founded in the autumn of 2012 at the company „Codru-ST” Ltd. The subject of the experience was Idared apple variety grafted on M9 rootstock. The trees were as Slender Spindle. The distance plantation is 3.5 x 0.8 m.

To study the influence of fertilization with zinc products on the fructification of apple plantation was experimented the following variants: 1. Control – no treatment; 2. Basfoliar Flo Zn - 1.0 L/ha; 3. Nertus Zinc - 2.0 L/ha; 4. Nertus Zinc - 3.0 L/ha.

The Basfoliar Flo Zn fertilizer was applied once by spraying in the intensive growth phase of the fruit. The first treatment with Nertus Zinc was given in the pink button phase, the second - after flowering, and the third - in the binding phase - the intensive growth of the fruits.

The treatment was made with portable sprayer in the early morning hours without wind. The quantity of solution per tree was 0.3 liters considering the amount of trees per unit area and the quantity of water needed which is 1000 L/ha.

The average weight of a fruit, production per tree and per unit area and their redistribution in diameter were established during harvest.

The evaluation was performed using apple firmness penetrometer FT 327, which secures ingress resistance of pulp a piston area of 1 cm<sup>2</sup>. Were conducted 10 assessments of firmness, being recorded media.

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

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%, forth – 76 - 90% and fifth – 90% or more from the fruit surface.

## RESULTS AND DISCUSSIONS

The investigations carried out (tab. 1) show that treatment with the Nertus Zinc foliar fertilizer positively influenced the weight of zinc in the leaves of Idared apple trees.

If, in the control variant, as a result of the foliar diagnosis, zinc content in the leaf is 25 ppm, then the variants treated with foliar fertilizers increased and constituted 32-41 ppm. It was basically recorded that zinc in the plant increased by 28.0 - 64.0%, compared to the control variant.

The increase of zinc content in the plant is favorable because for a normal course of physiological processes in the apple trees, it is recommended that the zinc supply level is 25-50 ppm.

The results obtained show that in the case of control variant the zinc content is at the lower limit (25 ppm). Basfoliar Flo Zn fertilizer treatments

increased zinc in the plant to 32 ppm, or 28.0% compared with the control variant. This increase of the element in question is explained by the fact that its share in the composition of the foliar fertilizer is 635 g/l, or 43.0%.

In the case of the Nertus Zinc foliar fertilizer treatment, the weight of the element in the plant was higher than the recommended minimum standard with 36.0-64.0%, representing 34-41 ppm.

Table 1

**The influence of foliar fertilizer on zinc content in the leaves of Idared apple trees, ppm**

| <b>Variants</b>            | <b>Zinc content</b> |
|----------------------------|---------------------|
| Control                    | 25                  |
| Basfoliar Flo Zn, 1.0 L/ha | 32                  |
| Nertus Zinc, 2.0 L/ha      | 34                  |
| Nertus Zinc, 3.0 L/ha      | 41                  |

Studying the influence of the treatment dose on the zinc content in the plant, we note that with its increase the value of the studied index increases. In the case of treatment with Nertus Zinc at the rate of 2.0 L/ha, the amount of zinc in the leaf constituted 32 ppm and with the increase of the dose to 3.0 L/ha, the studied index increased by 20.5% compared with the previous variant. The higher content of zinc in the plant during that period has a significant influence on the growth of shoots, blooming and the degree of fruit binding.

Fruit production is the final index, which demonstrates how all agro-technical measures have been carried out in the Idared apple plantation.

The investigations show that the number of fruits in the crown of the trees included in the research differs according to the variants in the study (tab. 2). If, in the control variant, without treatment, the number of fruit was 51 pcs/tree, then in the variant treated with the Basfoliar Flo Zn fertilizer were 52 pcs/tree. When treating the trees with Nertus Zinc in the dose of 2.0 l/ha the studied index was 57pcs/tree, and in the variant treated with Nertus Zinc foliar fertilizer in dose of 3.0 L/ha - 56 pcs/tree.

This partial increase in the number of fruit in the tree crown was due to a higher degree of fruit binding after treatment with the Nertus Zinc foliar fertilizer until and after the flowering period.

The difference between the control variant and the Basfoliar Flo Zn variant was 1 pcs/tree, between the Nertus Zinc variant at the dose of 2.0 L/ha - 6pcs/tree, and from the Nertus Zinc variant in the dose 3.0 L/ha -5 pcs/tree.

The average weight of a fruit on the variants in the study did not show large changes under the influence of the fertilizers used compared to the number of fruits per tree. The lowest average fruit weight was recorded in the variant treated with Nertus Zinc in dose of 2.0 L/ha - 174.1 g followed in ascended order by the

control variant - 174.2 g, the variant Nertus Zinc in dose of 3.0 L/ha - 174.7 g and the variant treated with the Basfoliar Flo Zn fertilizer, where the average weight of a fruit was 176.4 g, or an increase of 2.2 g compared to the control variant. This slight difference in average weight of fruits in variants 3 and 4 is due to the negligible number of fruits and under the influence of the Nertus Zinc foliar fertilizer. The results outlined above are also confirmed by statistical processing.

Table 2

**The influence of the zinc fertilization on production and quality parameters of Idared apple variety**

| Variants                   | Number of fruits, pcs/tree | Average weight, g | Production |         | Comparing with control variant, % |
|----------------------------|----------------------------|-------------------|------------|---------|-----------------------------------|
|                            |                            |                   | kg/tree    | kg/tree |                                   |
| Control                    | 51                         | 174.2             | 8.88       | 31.71   | 100.0                             |
| Basfoliar Flo Zn, 1.0 L/ha | 52                         | 176.4             | 9.17       | 32.74   | 103.2                             |
| Nertus Zinc, 2.0 L/ha      | 57                         | 174.1             | 9.92       | 35.42   | 111.7                             |
| Nertus Zinc, 3.0 L/ha      | 56                         | 174.7             | 9.78       | 34.92   | 110.0                             |
| DL 5%                      | 2.4                        | 7.3               | 0.44       | 1.46    | -                                 |

The fruit production on a tree and on a surface unit correlates directly with the number of fruits and their average weight. The smallest fruit production was recorded in the control variant, constituting 8.88 kg / tree or 31.71 t/ha.

In the variant treated with the Basfoliar Flo Zn fertilizer, the fruit production constituted 9.17 kg/tree or 32.74 t/ha, or an increase of 3.2% compared to the control variant, without treatment.

The highest fruit production was recorded in the variant treated with the Nertus Zinc foliar fertilizer in dose of 2.0 L/ha, constituting 9.92 kg/tree or 35.42 t/ha. Slightly lower values were recorded in the variant treated with Nertus Zinc foliar fertilizer in dose of 3.0 L/ha - 9.78 kg / tree or 34.92 t/ha. The insignificant difference between Nertus Zinc variants at 2.0 l/ha and Nertus Zinc at 3.0 L/ha is also demonstrated by statistical data.

Statistical data on fruit production on a tree and on a surface unit shows a statistical difference between the control variant and the Nertus Zinc variants at 2.0 L/ha and Nertus Zinc at a dose of 3.0 L/ha.

The results show that the Nertus Zinc foliar fertilizer in dose of 2.0 l/ha and 3.0 L/ha used to prevent zinc deficiency influenced the amount of fruits and the productivity of the plantation.

It is very important that apples are harvested at the optimum time. The data of the investigations carried out (tab. 3) show that the firmness of the apple pulp on the variants in the study at the time of the harvest constituted 7.2 - 7.5kg/cm<sup>2</sup>.

The smallest firmness of the pulp was recorded in the control variant without treatment - 7.2 kg/cm<sup>2</sup>.

When treatments with foliar fertilizers were carried out, there is an insignificant increase in pulp firmness. In the standard variant where Basfoliar Flo Zn foliar fertilizer treatment was performed, the firmness of the pulp increased and constituted 7.4 kg/cm<sup>2</sup>, or by 0.2 kg/cm<sup>2</sup> higher compared to the control variant.

In variants treated with Nertus Zinc, it was recorded approximately the same values of pulp firmness as in the Basfoliar Flo Zn variant, but larger as in the control variant. In the given case, the studied index constituted 7.3 - 7.5 kg/cm<sup>2</sup>, or an increase of 0.1 - 0.3 kg/cm<sup>2</sup> compared to the control variant. The increase in the treatment dose did not significantly affect the firmness of the pulp.

The content of soluble dry substance depends of the variety, after which can be determined the optimum harvesting time. The investigations show that the quantity of soluble dry substances in the Idared variety on the variants in the study constituted 13.6 - 13.9%.

Table 3

**The influence of zinc fertilization on biochemical and coloring indexes in apple fruit of Idared variety**

| Variants                   | Firmness, kg/cm <sup>2</sup> | Soluble dry substance, % | Titrateable acidity, % | Coloration index |
|----------------------------|------------------------------|--------------------------|------------------------|------------------|
| Control                    | 7.2                          | 13.6                     | 0.51                   | 2.1              |
| Basfoliar Flo Zn, 1.0 L/ha | 7.4                          | 13.8                     | 0.48                   | 2.5              |
| Nertus Zinc, 2.0 L/ha      | 7.3                          | 13.8                     | 0.49                   | 3.7              |
| Nertus Zinc, 3.0 L/ha      | 7.5                          | 13.9                     | 0.49                   | 3.8              |

The smallest value of the shear of the soluble dry substances was recorded in the control variant - 13.6%. In the case of foliar fertilizers treatment, we record an increase in the studied index to 13.8 - 13.9%. That is, when treating with the Basfoliar Flo Zn fertilizer, the amount of fruit-soluble dry substance increased by 0.2% compared to the control variant.

Treatments with Nertus Zinc foliar fertilizer on both variants increased by 0.2 - 0.3% compared to the control variant and by 0.1% compared to the standard variant. Therefore, foliar fertilizer treatments have had an insignificant effect on increasing the amount of soluble dry substance.

The share of titrateable acids in fruits is in direct dependence on the amount of soluble dry substance. Simultaneously, with decreasing the quantity of dry soluble substance in fruits, the titrateable acids weight increased, with the highest value in the control variant - 0.51%.

In the case of the Basfoliar Flo Zn variant, the amount of titrateable fruit

acids was 0.48%, or a 0.03% decrease compared to the control variant.

Treatments with the Nertus Zinc foliar fertilizer reduced the titration of the titrated acids to 0.49%, or a 0.03% decrease compared to the control variant.

Color is a major feature for assessing fruit quality, and an indicator for determining maturation for harvesting. Color is a characteristic of the variety and is determined by the presence of pigments in epidermal cells.

Conducted investigations show that the lowest coloration index was recorded in the control variant being 2.1 points.

Basfoliar Flo Zn fertilizer treatments intensified slightly the coloring index, representing 2.5 points, or an increase of 0.4 points compared to the control variant.

In the variants treated with the Nertus Zinc foliar fertilizer the index of coloring improved and constituted 3.7 - 3.8 points, or an increase of 76.2 - 80.9% compared to the control variant and 48.0% compared to Basfoliar Flo Zn.

## CONCLUSIONS

1. The Nertus Zinc foliar fertilizer has positively influenced the prevention of zinc deficiency, fruit production compared to the control variant and Basfoliar Flo Zn.

2. Same values of pulp firmness, soluble dry substance, titratable acidity and fruit coloring index are recorded when treatment with the Nertus Zinc foliar fertilizer in dose of 2.0 L/ha and at dose 3, 0 L/ha were made.

3. When foliar fertilizer was used to prevent Zinc deficiency in plants, higher yields and superior quality were recorded in the Nertus Zinc variant in dose of 2.0 L/ha, applied three times by foliar spraying. The first fertilization should be made in the pink button phase, the second after the flowering, and the third in the binding phase - the intensive growth of fruits.

## REFERENCES

1. Babuc V., 2012 - *Pomicultura*. Chișinău, p. 348-354.
2. Babuc V., Peșteanu A, Gudumac E., Cumanici A., 2013 - *Producerea merelor*. Ed. Bonss Office, Chișinău, p.158-169.
3. Cimpoieș Gh., 2012 - *Cultura mărului*. Chișinău, p. 303-337.
4. Ghena N., Braniște N. Stănică Fl., 2004 - *Pomicultura generală*. Ed. MatrixRom, București,, p. 391-422.
5. Orphanos P.I., 1982 - *Spray and soil application of zinc to apples*. Hortscience 57(3), p. 259-266.
6. Swietlik D. 2002 - *Zinc Nutrition of Fruit Crops*. HortTehnology, 12(1), p. 56-60.
7. Toma S., 2008 - *Aplicarea îngrășămintelor în agricultura durabilă*. Chișinău, p 136-153.
8. Voiculescu N., Hoza D., Spiță V., 2006 - *Nutriția cu elemente minerale la pomi și arbuști fructiferi*. Partea I, București, 263 p.