

The influence of a complex of amino acids of plant origin with microelements on the yield and quality of apple trees

*M T Mukhina*¹, *M E Lammas*^{1*}, *A A Korshunov*¹, and *R A Borovik*¹

¹FGBNU "VNII Agrochemistry", 31A, st. Pryanishnikova, Moscow, 127550, Russia

Abstract. The article is devoted to the study of the influence of a complex of amino acids of plant origin with microelements on the yield and quality of the Lobo apple tree in 2019-2020. In our studies, we studied the effect of a complex of amino acids of plant origin with microelements in three doses of 0.5, 1.0 and 1.5 l/ha on the main factors of plant development to obtain a high-quality yield. We have found that during the growing seasons 2019–2020. When assessing the effect of two-time foliar feeding of apple trees of the Lobo variety with amino acids of plant origin + microelements, a positive effect of the fertilizer was found, most manifested at a fertilizer consumption of 1.5 l/ha and a working solution of 800 l/ha. Thus, the use of an agrochemical contributed to the development of generative productivity of plants: an increase in yield in 2019 by 13.9%, by 14.5% in 2020, the average weight of one fruit - by 12.1% in 2019, by 16.4% in 2020, fruit set - in 2019 by 0.4%, in 2020 by 0.6%, as well as in improving the biochemical parameters of the fruit. The vitamin C content in 2019 in this variant was 11.8%, in 2020 – 10.4%.

1 Introduction

In the modern world, the market for agrochemicals, fertilizers, and pesticides is developing rapidly. Keeping up with current trends is sometimes difficult. New innovative forms of agrochemical products are emerging. But, always when introducing a new product to the market, experts already know that it is based on a traditional set of components with the addition of new types of fertilizers [6].

Extensive research has proven that amino acids play a positive role in increasing the yield and quality of plants when sprayed at different stages of growth. The effects of amino acids are particularly noticeable during critical phases such as the tillering and flowering stages or under stressful conditions (such as drought, heat, frost, salinity or pathogens). They help reduce the stress effects of drought and salinity through various physiological activities [4].

By changing the osmotic potential of plant tissues, amino acids also significantly reduce damage caused by biostress. They stimulate growth processes in plants, are responsible for

* Corresponding author: lammas.me@mail.ru

cell division and the production of some natural growth hormones such as IAA and GA₃, and therefore contribute to increased yield and improved quality [7, 9].

It is noted that amino acids contribute to entomological and phytopathological protection of plants [8].

At the moment, more than 50 drugs containing amino acids are officially registered. And this is just the beginning. Progress does not stand still.

In this regard, the purpose of the study was to study the effect of amino acids of plant origin based on a complex of microelements on the growth, development and productivity of apple trees.

2 Materials and methods

Experimental work was carried out in 2019-2020. in the conditions of the Non-Chernozem Zone of the Russian Federation, the Central Horticulture Zone, the Moscow Region, the Leninsky District. The experience was laid in the Leninsky branch of the technology testing department of the FGBNU VSTISP in an intensive apple orchard on clonal rootstocks ("Trellis Garden"), row No. 18.

The testing site belongs to the central part of the Russian Plain, to the second agroclimatic region of the Moscow region and is located in its central part. The climate is characterized by warm summers, moderately cold winters with stable snow cover and well-defined transition seasons. Σ toC – 1900-2100°, GTK – 1.3-1.4. [1, 5].

The soil of the experimental plot is soddy-podzolic on cover loams, medium loamy. Humus content - 1.5-1.8%, P₂O - 68 mg/100 g soil, K₂O - 28 mg/100 g soil, N - 9.28 mg/100 g soil, Ph_{KCl} 6.8.

The object of the study is the Lobo apple tree (*Malus domestica* R.), a winter variety, included in the State Register in 1972 [2].

The year the garden was planted was 2001. Planting pattern was 4.5x3.0 m, rootstock was 62-396. The research was carried out according to the generally accepted field experiment methodology. The technology of apple tree cultivation, with the exception of the studied options, is generally accepted for this zone [3].

3 Results and Discussion

During the growing season 2019-2020. Temperature conditions were generally favorable for plant growth and development. The average ten-day temperature in 2019 was lower than the conditions in 2020, but slightly higher than the long-term average [3].

May 2020 was characterized by heavy precipitation, compared to 2019 and the long-term average. June 2020 was characterized by hot and dry weather, so the average monthly temperature was 21.4°C. The summer months of 2019-2020 were hot. 2020 turned out to be a relatively hot year in terms of temperature. In general, no significant weather deviations were observed during the period April-October 2019 (Figure 1).

Experience scheme:

- Control – b/o.
- amino acids + microelements – 0.5 l/ha.
- amino acids + microelements – 1.0 l/ha.
- amino acids + microelements – 1.5 l/ha.

Spraying of plants in the studied doses was carried out during the formation of inflorescences and at the beginning of flowering. The consumption of the working solution is 800 l/ha.

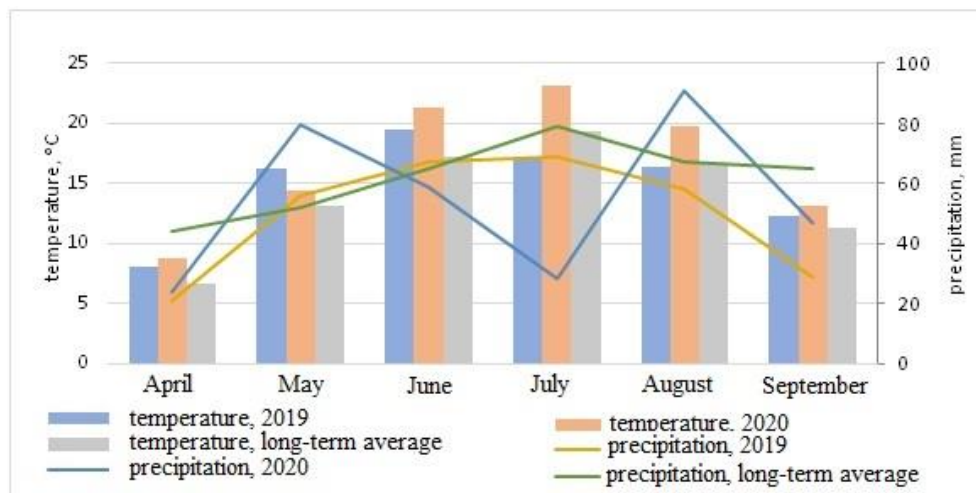


Fig. 1. Climatic conditions of the experiment, 2019-2020.

Table 1. Productivity of Lobo apple tree plants, 2019-2020.

| Experience Option | Weight of apples from 1 tree, average for variant, kg/plant | | Number of apples per tree, average for option, pcs./plant | | Average weight of one apple, g | |
|---|---|-------|---|-------|--------------------------------|-------|
| | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 |
| Control | 15.48 | 16.21 | 124.8 | 125.9 | 0.124 | 0.128 |
| amino acids of plant origin + microelements at a dose of 0.5 l/ha | 17.21 | 18.92 | 125.6 | 126.8 | 0.137 | 0.146 |
| amino acids of plant origin + microelements at a dose of 1.0 l/ha | 17.61 | 19.08 | 126.7 | 127.4 | 0.139 | 0.148 |
| amino acids of plant origin + microelements at a dose of 1.5 l/ha | 17.63 | 19.34 | 126.8 | 128.1 | 0.139 | 0.149 |
| HCP ₀₅ | 0.84 | 1.06 | 4.1 | 5.05 | 0.09 | 1.02 |

When using a complex of amino acids of plant origin with microelements, the indicators of the weight and number of fruits per plant, the average weight of one apple increased in 2019 and 2020. The best result based on the results of two years of research was shown by double foliar feeding with a fertilizer consumption of 1.5 l/ha - 13.9% higher than the control in 2019, and 19.3% in 2020. The number of apple fruits was also higher by 1.6%, the average weight of one apple was by 12.1%, and in 2020 it was higher by 1.7% and 16.4%, respectively.

Table 2. Productivity of Lobo apple tree plants, 2019-2020.

| Experience Option | Average yield, c/ha | | Yield increase | | | |
|---|---------------------|-------|----------------|------|------|------|
| | 2019 | 2020 | 2019 | | 2020 | |
| | | | c/ha | % | c/ha | % |
| Control | 114.7 | 115.2 | - | - | - | - |
| amino acids of plant origin + microelements at a dose of 0.5 l/ha | 127.5 | 128.4 | 12.8 | 11.2 | 13.2 | 11.5 |
| amino acids of plant origin + microelements at a dose of 1.0 l/ha | 130.5 | 131.3 | 15.8 | 13.8 | 16.1 | 13.9 |
| amino acids of plant origin + microelements at a dose of 1.5 l/ha | 130.6 | 131.9 | 15.9 | 13.9 | 16.7 | 14.5 |
| HCP ₀₅ | 5.9 | 6.5 | | | | |

During the growing season of 2019, the yield of the Lobo apple tree was maximum in the variant with the use of amino acids of plant origin + microelements with a fertilizer consumption of 1.5 l/ha and amounted to 130.6 c/ha, which is 13.9% higher than the control variant. In 2020, this treatment option also showed high results among the experimental options studied. The apple tree yield was 131.9 c/ha, which is 14.5% higher than the option without treatment. In general, over two years of research, all options with treatment with a complex of amino acids and microelements showed a beneficial effect on the yield of apple trees.

Table 3. Intensity of flowering and fruit set of the Lobo apple tree, 2019-2020.

| Experience Option | Flowering intensity 2019-2020 | Fruit set, % | |
|---|----------------------------------|--------------|------|
| | | 2019 | 2020 |
| Control | Strong | 15.1 | 15.3 |
| amino acids of plant origin + microelements at a dose of 0.5 l/ha | Strong | 15.3 | 15.6 |
| amino acids of plant origin + microelements at a dose of 1.0 l/ha | Strong | 15.6 | 15.8 |
| amino acids of plant origin + microelements at a dose of 1.5 l/ha | Strong | 15.5 | 15.9 |
| HCP ₀₅ | | 0.3 | 0.5 |

Foliar feeding of apple plants with plant-derived amino acids + microelements contributed to the trend towards an increase in fruit set. The highest fruit set was detected in the experimental variant with a fertilizer consumption of 1.0 l/ha in 2019, and with a consumption of 1.5 l/ha in 2020. Fruit set in 2019 was 15.6%, in 2020 - 15.9, which is higher than the control variant by 0.5 and 0.6%, respectively.

Table 4. Growth and development of Lobo apple tree plants, 2019-2020.

| Experience Option | Total growth length, cm/plant | | Average length of one shoot, cm/shoot | | Number of shoots on one plant, pcs./plant | |
|---|-------------------------------|------|---------------------------------------|------|---|-------|
| | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 |
| Control | 3225 | 3260 | 31.6 | 32.3 | 102.1 | 104.3 |
| amino acids of plant origin + microelements at a dose of 0.5 l/ha | 3560 | 3610 | 31.9 | 32.5 | 111.6 | 115.3 |
| amino acids of plant origin + microelements at a dose of 1.0 l/ha | 3430 | 3520 | 31.7 | 32.1 | 108.2 | 110.6 |
| amino acids of plant origin + microelements at a dose of 1.5 l/ha | 3270 | 3340 | 31.9 | 32.2 | 102.5 | 106.9 |
| HCP ₀₅ | 165 | 178 | 0.3 | 0.4 | 7.9 | 8.5 |

The use of an amino acid complex of plant origin with microelements did not have a significant effect on the vegetative productivity of apple plants either in 2019 or in 2020. In both years of the study, there was a tendency for indicators to increase compared to the control.

Table 5. Biochemical composition of Lobo apples, 2019-2020.

| Experience Option | Ascorbic acid (vitamin C), mg% | | Total sugars, % | | Sugar-acid index | | Nitrates, mg/kg | |
|---|--------------------------------|------|-----------------|------|------------------|------|-----------------|------|
| | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 |
| Control | 8.9 | 9.1 | 12.3 | 11.9 | 20.8 | 20.9 | 19.4 | 19.1 |
| amino acids of plant origin + microelements at a dose of 0.5 l/ha | 9.5 | 9.6 | 11.8 | 12.1 | 20.7 | 20.4 | 22.8 | 21.9 |
| amino acids of plant origin + microelements at a dose of 1.0 l/ha | 9.4 | 9.4 | 12.2 | 12.3 | 19 | 19.3 | 21.4 | 21.1 |
| amino acids of plant origin + microelements at a dose of 1.5 l/ha | 11.8 | 10.4 | 12.3 | 12.3 | 22.7 | 21.2 | 17.8 | 18.3 |

The biochemical composition of apple fruits was higher in the treatment options, where the sugar and ascorbic acid content reached a maximum compared to the control. Thus, the

maximum indicators were noted in the experimental variant with a dose of 1.5 l/ha, where they amounted to 11.8% in 2019, 2020. – 10.4%, which is higher than the control by 2.9 and 1.3%, respectively.

Acidity levels decreased. Nitrate content is within the MPC. The organoleptic characteristics and appearance of apples did not change significantly over the years of the study. According to the tasting results, the taste of apples was sweet and sour, tonic, 8.0 points for all variants of the experiment. The apples were well colored, one-dimensional, with juicy flesh. The appearance of apples in 2019 and 2020 was rated 9.0 points. The overall score reached 8.5 points (Figure 2).

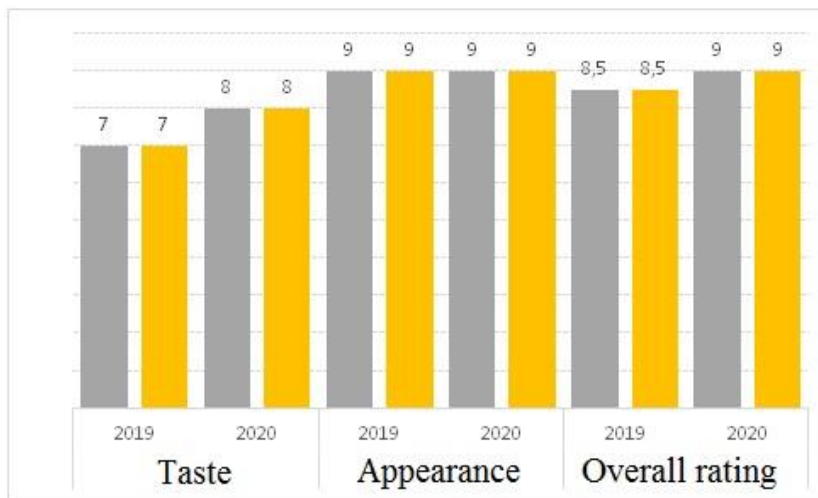


Fig. 2. Organoleptic characteristics of apple fruits of the Lobo variety, 2019–2020. (point).

4 Conclusion

For the growing seasons 2019–2020 When assessing the effect of two-time foliar feeding of apple trees of the Lobo variety with amino acids of plant origin + microelements, a positive effect of the fertilizer was found, most manifested at a fertilizer consumption of 1.5 l/ha and a working solution of 800 l/ha. Thus, the use of an agrochemical contributed to the development of generative productivity of plants: an increase in yield in 2019 by 13.9%, by 14.5% in 2020, the average weight of one fruit - by 12.1% in 2019, by 16.4% in 2020, fruit set - in 2019 by 0.4%, in 2020 by 0.6%, as well as in improving the biochemical parameters of the fruit. The vitamin C content in 2019 in this variant was 11.8%, in 2020 – 10.4%.

Our studies of the amino acid composition with microelements on the Lobo apple tree in 2019–2020 showed that the use of this fertilizer when cultivated on well-cultivated sod-podzolic soil in the conditions of the Moscow region is most effective with double foliar feeding of plants with a fertilizer consumption of 1.5 l/ha and working solution 800 l/ha.

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