Testing of the new fertilizer "Multibar" for the agronomic properties of tomatoes in Armenia

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Abstract. The article considers the testing of the fertilizer "Multibar" for biological, agronomic properties and biochemical characteristics of fruits of tomato varieties for fresh consumption - Noy, for canning - Renaissance, cherry type - Rubin in three options - 1. Without treatment (control), 2. Treatment with ammonium nitrate , 3. Processing "Multibar". The results of the test showed that the use of the new fertilizer "Multibar" provided for an increase in crop efficiency and fruit quality. The new fertilizer "Multibar" can be effectively introduced in the republic and similar regions of the globe.

1. Introduction

Liquid complex fertilizers were first produced in the USA in 1950, in 1957 in England, in 1960 in France, and then in other European countries. In the former USSR, liquid complex fertilizers (abbreviated LCF) have been produced since 1980. In the same year, the first 26,000 tons of 10-34-0 fertilizers were produced, and in 1984 the first million tons were already produced in the USSR.

According to a report included in the United Nations Population Fund's "World Population Dashboard" and the United Nations Population Division's "Global Population Outlook", the UN predicts that the number of people in the world will increase by 2 billion over the next 30 years. Up to 9.7 billion people by 2050, and by 2100 the population will reach 11 billion. People Index: Therefore, the development of sustainable global food security systems is becoming one of the most important tasks of the world community.[1-2]

One of the ways to solve this problem is the development and application of highly effective fertilizers. The policy we have adopted is to work on improving the efficiency of the fertilizers we use. As a result, we have developed and received an innovative, highly efficient PDA "Multibar". It is environmentally friendly, non-toxic and non-explosive, non-flammable product, waste-free production. Our laboratory, which develops Multibar, is focused on the development and modernization of innovative technologies, as a result of which we have developed and introduced such products as the Bioxil 2 disinfectant, the LA-2 rust converter.

According to the decision taken by the Government of the Republic of Armenia in 2015, the termination of the program "State support for the purchase of nitrogen, phosphorus and potash..."
fertilizers at affordable prices for land users of the Republic of Armenia", as well as the low efficiency of the solid fertilizers used, gave rise to a thorough work on the development and production ZhKU [3].

Innovation ZhKU "Multibar" is, For the nutrition of plant fertilizers, both liquid and solid complex fertilizers use three main nutrients: nitrogen, phosphorus and potassium. Nitrogen is especially necessary for plants during the growing season, it contributes to the growth of the plant body (stem, branches) and fruits and the growth of green mass. Phosphorus increases the tolerance of plants to drought by helping to retain water at the cellular level and increasing the nutrient content of fruits. Potassium contributes to the absorption of carbon dioxide (CO$_2$) from the atmosphere, increases frost resistance and drought resistance of plants.[4] In addition to the three main components mentioned above, "Multibar" also includes other macro- and microelements, in particular zinc, manganese, iron, copper, boron, sulfur, molybdenum, etc., as well as a complexing compound, to increase the efficiency of assimilation by plants macro- and microelements [5-6].

The amount of these chemical elements is closely related to the chemical composition of agricultural land, the chemical composition of water used for irrigation, and the need for crops in macro- and microelements. In general, the effectiveness of "Multibar" lies in the correct calculation of the ratio of chemical elements and complexing compounds in the composition, depending on the type of crop, variety, growing season, soil type and the amount of necessary elements in it [7-10]. ZhKU "Multibar" environmentally friendly, non-toxic and non-explosive, non-flammable product, waste-free production. The pH of the finished fertilizer solution is in the range of pH = 6.5-7.7. The normal concentration of an undiluted Multibar solution is 2-3 grams per 1 liter of water. It must be taken into account that in order to obtain a working solution, the concentrate must be diluted with water 10,000 times, which has been proven by field experiments.

Table 1. The chemical composition of "Multibar" is presented below.

| Chemical composition | Percentage of components |
|----------------------|--------------------------|
| Bor (B)              | > 1 %                    |
| Iron (Fe)            | > 1 %                    |
| Manganese (Mn)       | > 0.1 %                  |
| Molybdenum (Mo)      | > 0.01 %                 |
| Copper (Cu)          | > 1 %                    |
| Zinc (Zn)            | > 0.1 %                  |
| Potassium (K)        | > 1.6 %                  |
| Nitrogen (N)         | > 1.2 %                  |
| Phosphorus (F)       | > 1 %                    |
| Sulphates (SO$_4^{2-}$) | > 0.1 %    |
| Organic complexing agent. | 0.01 %        |

Mineral fertilizers, by the decision of the Government of the Republic of Armenia, are industrially obtained or fossil fertilizers containing a nutrient element. A nutrient is a component of fertilizer necessary for the growth and development of plants [10-15].

Nutrients fall into three main groups:

- Key nutrients: nitrogen (N), phosphorus (P), potassium (K).
- Secondary nutrients (macroelements) - calcium (Ca), magnesium (Mg), sulfur (S), the content of which in plants and soil ranges from a few to hundredths of a percent in terms of dry matter.
• Trace elements: boron (B), manganese (Mn), copper (Cu), zinc (Zn), cobalt (Co), molybdenum (Mo), iron (Fe), the content of which in plants and soil is not more than one thousandth of a percent more, in terms of dry matter.

The liquid complex fertilizer "Multibar" developed and created by us is an aqueous solution that contains macro- and microelements and an organic complexing compound.

2. Materials and methods
The testing of "Multibar" fertilizers was carried out at the sites of the Scientific Center for Vegetable, Melon and Industrial Crops of the Ministry of Agriculture of the Republic of Armenia in the period for 2020-2021. The experiments were carried out in quadruple replication according to the method of randomization (AVRDC) [16]. Treatments were carried out on tomato varieties for fresh consumption - Noi, for canning - Renaissance, and cherry type - Rubin in three options - 1. Without treatment (control), 2. Treatment with ammonium nitrate, 3. Treatment "Multibar". Plants were treated with Multibar fertilizer 3 times after planting with a 20-day interval, at a rate of 3g. per 1 liter, and ammonium nitrate 2 times, at a rate of 250 kg per hectare. The content of dry substances in fruits was determined by a refractometer, sugars - by Bertrand, vitamin C - by Muri, acidity by titration method [17]. The concentration of nitrates in the product using the Morion OK2i nitrate tester. Yield data were subjected to mathematical processing by the method of analysis of variance [18].

3. Results and Discussion
The results of the test showed that the "period from germination to ripeness" in the tomato variety for fresh use - Noy, when treated with "Multibar" was 118, when treated with ammonium nitrate 120, with control 128 days. The 3rd variant, which surpassed the control by 10 days, and the 2nd variant by 8 days, differed in early maturity. In the tomato variety for canning - Renaissance, the "period from germination to ripeness" when treated with "Multibar" was 95, when treated with ammonium nitrate 97, with a control of 100 days. The 3rd variant was distinguished by early maturity, which surpassed the control by 5 days, and the 2nd variant by 3 days. In a tomato variety of the Cherry-Rubin type, the "period from germination to ripeness" when treated with Multibar was 100, when treated with ammonium nitrate 105 with control 110 days. The 3rd variant, which surpassed the control by 10 days, and the 2nd variant by 5 days, differed in early maturity. (figure 1)

The results of the test showed that the yield of the tomato variety for fresh use - Noy, when treated with "Multibar" was 1100.5 c/ha, when treated with ammonium nitrate 1095.4 c/ha, with control 750.2
The yield was different in the 3rd variant, which surpassed the control by 350.3 c/ha, and the 2nd variant by 345.2 c/ha. The yield of the tomato variety for canning - Renaissance when treated with "Multibar" was 950.4 c/ha, when treated with ammonium nitrate 940.5 c/ha, with control 560.7 c/ha. The yield was different in the 3rd variant, which surpassed the control by 389.7 c/ha, and the 2nd variant by 379.8 c/ha. The yield of the cherry tomato variety - Rubina when treated with "Multibar" was 600.5 c/ha, when treated with ammonium nitrate 590.4 c/ha, with control 321.3 c/ha. The yield was different in the 3rd variant, which surpassed the control by 279.2 c/ha, and the 2nd variant by 269.1 c/ha. (figure 2)

![Figure 2. Productivity HCP_{0.95}=14.2 q/ha, S x%=3.4.](image)

The average fruit weight in the tomato variety for fresh consumption - Noy when treated with "Multibar" was 225.5 g, when treated with ammonium nitrate 218.4 g, in the control 170.3 g. The average fruit weight in the tomato variety for canning - Renaissance when treated with "Multibar" was 75.5 g, when treated with ammonium nitrate 72.6 g, when controlled 51.4 g, with ammonium nitrate 15.4 g, with control 10.2 g. (figure 3)

![Figure 3. The average weight of the fetus, g.](image)
Figure 4. Tomato variety for fresh use - Noy: a) untreated, control; b) ammonium nitrate treatment; c) "Multibar" processing.

Figure 5. Tomato variety for canning - Renaissance: a) untreated, control; b) ammonium nitrate treatment; c) "Multibar" processing.

Figure 6. Cherry tomato variety - Rubina: a) untreated, control; b) ammonium nitrate treatment; c) "Multibar" processing.
The content of solids in the variety of tomato for fresh consumption - Noy when treated with "Multibar" was 7.4%, when treated with ammonium nitrate 7.2%, when controlled - 6.8%. The content of sugars in the treatment of "Multibar" was 3.6%, in the treatment of ammonium nitrate 3.5%, in the control - 3.1%, the content of vitamin C - respectively - 39.4, 38.45, 29.02 mg%, acidity - 0.48, 0.48, 0.49% concentration of nitrates in the product - 40, 49, 35%. The content of solids in the tomato variety for canning Renaissance - when treated with "Multibar" was 7.2%, when treated with ammonium nitrate 7.1%, when controlled - 6.5%, the sugar content when treated with "Multibar" was 3.5% , when treated with ammonium nitrate 3.4%, with control - 3.0%, the content of vitamin C - respectively - 38.50, 37.40, 28.05 mg%, acidity - 0.48, 0.48, 0, 51%, the concentration of nitrates in the product - 41, 48, 36%. The content of solids in the tomato variety of the Cherry Rubina type - when treated with "Multibar" was 7.7%, when treated with ammonium nitrate 7.0%, when controlled - 6.7%, the sugar content when treated with "Multibar" was 3.4% , when treated with ammonium nitrate 3.4%, with control - 3.2%, the content of vitamin C - respectively - 37.65, 36.45, 27.50 mg%, acidity - 0.48, 0.48, 0, 49%, concentration of nitrates in the product - 41, 49, 35% (table 2).

**Table 2.** Biochemical indicators of tomato fruits, average for 2020-2021.

| Processing Options | Solids, % | Sakharov, % | Vitamin C, mg% | Acidity, % | The concentration of nitrates in the product, % |
|--------------------|-----------|-------------|----------------|------------|-----------------------------------------------|
| For fresh use, Variety Noy |           |             |                |            |                                               |
| Without processing, control | 6.8       | 3.1         | 29.02          | 0.49       | 35                                            |
| Ammonium nitrate treatment | 7.2       | 3.5         | 38.45          | 0.48       | 49                                            |
| Processing "Multibar" | 7.4       | 3.6         | 39.40          | 0.48       | 40                                            |
| For canning, Variety Renaissance |           |             |                |            |                                               |
| Without processing, control | 6.5       | 3.0         | 28.05          | 0.51       | 36                                            |
| Ammonium nitrate treatment | 7.1       | 3.4         | 37.40          | 0.48       | 48                                            |
| Processing "Multibar" | 7.2       | 3.5         | 38.50          | 0.48       | 41                                            |
| Cherry type, Ruby variety |           |             |                |            |                                               |
| Without processing, control | 6.7       | 3.2         | 27.50          | 0.49       | 35                                            |
| Ammonium nitrate treatment | 7.0       | 3.4         | 36.45          | 0.48       | 49                                            |
| Processing "Multibar" | 7.1       | 3.5         | 37.65          | 0.48       | 41                                            |

**4. Conclusion**
Testing the fertilizer "Multibar" for biological, agronomic properties and biochemical characteristics of fruits of tomato varieties for fresh consumption - Noy, for canning - Renaissance, cherry type - Ruby in three options - 1. Without treatment (control), 2. Ammonium nitrate treatment, 3. Processing "Multibar". The test results showed that the use of the new fertilizer "Multibar" ensured an increase in crop efficiency and fruit quality. The new fertilizer "Multibar" can be effectively introduced in the republic and similar regions of the globe.
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