The effect of potassium humate and micronutrients on the yield of cucumber fruits in greenhouse conditions

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Abstract. A hybrid Svyatogor F1 of Dutch breeding was grown in a winter greenhouse for three turns. Studies have shown that pre-sowing seed soaking treatment and foliar top dressing of plants with potassium humate did not affect germination, but positively affected plant growth, except for lithium carbon dioxide. For potassium humate and PABA, the leaf area increased, while for lithium it decreased. Micro fertilizers, except lithium, had a positive effect on the formation of fruits, their weight and yield. The largest yield of cucumbers was obtained by PABA and potassium humate mixed with other trace elements: 33.63 and 34.0 kg/m^2 with a control indicator of 30.75 kg/m^2. One foliage fertilization with micro fertilizers also had a positive effect: in terms of yield, the variant of a mixture of all fertilizers was in the first place - 34.75, the PABA with a yield of 33.93 kg/m^2 was in the second place, and 30.97 kg/m^2 were in the control. Lithium had a retarding effect on all indicators.

1 Introduction

The extremely important role of vegetable products in human nutrition and health is known. Vegetables contain many vital substances: proteins, carbohydrates, fats, vitamins, mineral salts, etc. [11]. In the daily diet of a healthy person, vegetables and fruits should account for from 15 to 20% of the food energy effect. Their use directly affects the life quality and expectancy of a person [3,8,10,11,13].

Greenhouse vegetable growing provides year-round production of vegetable products under any climatic conditions. It is a promising branch of crop production, so it is no coincidence that the number of entrepreneurs acquiring greenhouses is growing in the Republic of North Ossetia-Alania. One of the effective ways to increase the yield of vegetable crops is the rational use of mineral and organic fertilizers, as well as growth stimulants [2,3,9,12]. Their use in greenhouse conditions has not been studied enough, especially in epy North Ossetia-Alania.

In greenhouses, it is customary to prepare a nutrient solution from traditional mineral fertilizers, which are quite expensive. In this regard, it is relevant to study the effectiveness of biostimulants and micronutrients used in small volumes. They are relatively cheap, resource-saving.

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The cultivation of cucumber (about 70%), the fresh fruits of which have a high dietary value, has become the most widespread in protected soil [3,12,13]. The high importance of this product is confirmed by stable demand.

The growth of greenhouse cucumber production is possible due to an increase in greenhouse areas, an increase in the efficiency of their use, as well as the rational use of mineral, organic, micronutrients, and growth stimulants. At the same time, the production of environmentally safe vegetable products is achieved.

The purpose of the research was to study the effect of pre-sowing seed soaking treatment and foliar top dressing of plants with aqueous solutions of potassium humate and micronutrients on cucumber yield in a winter greenhouse.

2 Research methods

The experimental part of the research was carried out in one of the greenhouse complexes of the city of Vladikavkaz. The Dutch cucumber growing technology was used in the greenhouse. The object of study was a hybrid Svyatogor F1 of Dutch breeding.

After disinfection, the greenhouses were sown in 10 × 10 × 10 mineral cotton cubes in the first decade of September. The cubes were saturated with a nutrient solution (EC-1.7 mS/cm, pH-5,7) and covered with a plastic film until germination.

On the 3rd-4th day after the emergence of seedlings, additional illumination was carried out for 2 days, then reduced by 2 hours daily for a week. The value of illumination in the greenhouse was shown as a result of research by Grigorai E.E., et al.[4]. The planting density is 2.5 plants/m^2.

Care of plants after planting on mats included the following activities: trellising plants to twine, regular formation of plants (according to generally accepted schemes for parthenocarpic cucumber in autumn – winter turnover). The yellowing lower leaves, deformed ovaries and fructifying shoots were removed as the growing season progressed.

Relative humidity was maintained in the range of 70-75% before fruiting and 75-80% during fruiting.

The first yield of cucumber fruits was made on the 47th day after germination. The collections were carried out as the fruits grew almost every day. Standard cucumber fruits are from 10 to 16 cm [9,10,11,13]. The research methodology is described in more detail in the work [5].

Seed soaking treatment and foliar fertilizing were carried out in 0.1% solutions of the studied fertilizers. Each variant of the experiments was tested on 5 plants in 3-fold repetition [5].

3 Results and their discussion

During 3 revolutions, it was found that pre-sowing seed soaking treatment and foliar fertilizing did not affect the germination of seeds, except for lithium carbon dioxide, according to which seedlings appeared a little later (after 5 days versus 4.3 days in the control). Only potassium humate had a positive effect on plant growth (the height was 3 cm higher than the control), and lithium carbon dioxide inhibited it: the plant height on day 37 was 69 cm versus 85.4 cm in the control. Foliar dressing increased the plant height relative to the control by 1.2-1.5 cm.

Pre-sowing seed soaking treatment in combination with foliar fertilization of plants in the 37-day phase contributed to an increase in leaf area by 6 and 2 cm^2/plant according to potassium humate and PABA and a decrease in lithium carbon dioxide by 63.3 cm^2/plant on average, for 3 turns with a control indicator of 476.6 cm^2/plant.

Studies have shown that pre-sowing seed soaking treatment and foliar fertilization with solutions of micronutrients, except lithium carbon dioxide, had a positive effect not only on plant growth, but also on fruit formation, their weight and yield (Table 1).

Table 1. The effect of pre-sowing seed soaking treatment and foliar fertilizing of plants on the cucumber yield per plant, average for 3 turns

Variant	Number of fruits, pcs.	Weight of 1 fruit, kg	Number of fruits, pieces		Total fruit yield	
			standard	non-standard	kg/plant	kg/m^2
Control	56.3	0.220	53.6	2.7	12.30	30.75
Potassium humate	56.5	0.233	53.9	2.6	12.56	31.40
Cerium sulfate	56.4	0.237	53.7	2.7	13.25	33.13
PABA	56.6	0.239	54.1	2.5	13.45	33.63
Ammonium molybdate	56.8	0.236	53.9	2.9	13.30	33.25
Lithium carbon dioxide	52.1	0.217	50.9	1.2	11.28	28.20
Humate+microfertil.	57.3	0.239	54.8	2.5	13.60	34.00
LSD 05					0.15	

Average data indicate that the total effect of pre-sowing seed soaking treatment in solutions of potassium humate and micronutrients and foliar fertilization of plants was generally positive, which was expressed in a slight increase in the number of fruits per plant by 0.1-1.0 pieces, including standard 0.1-1.2 pieces. The weight of one fruit visibly increased relative to the control – by 0.013-0.019 kg. At the same time, the negative effect of lithium carbon dioxide on these indicators should be noted. It is possible that the concentration of the solution of this trace element used was excessive, as a result of which the yield decreased by 2.55 kg compared to the control. For the rest of the fertilizers, it has increased significantly: the increase in yield exceeds the LSD value. The best result was obtained for PABA variants and a mixture of potassium humate with trace elements – 33.63 and 34.00 kg per 1 m^2 with a control indicator of 30.75 kg/m^2.

Experiments have established (Table 2) that under the action of only foliar fertilizing, as a result of improving the indicators of growth processes, the number of fruits on the plant increased compared to the control, the weight of the fruit, the number of standard fruits, as well as the total yield.

Table 2. Effect of foliar fertilizing on the cucumber yield per plant, average for 3 turns

Variant	Number of fruits, pcs.	Weight of 1 fruit, kg	Number of fruits, pieces		Total fruit yield	
			standard	non-standard	kg/plant	kg/m^2
Control	56.3	0.220	53.6	2.7	12.39	30.97

Potassium humate	56.5	0.233	54.2	2.3	13.09	32.73
Cerium sulfate	56.2	0.234	53.0	3.2	13.03	32.58
PABA	56.1	0.245	52.7	3.4	13.57	33.93
Ammonium molybdate	56.3	0.233	53.5	2.8	13.02	32.55
Lithium carbon dioxide	56.1	0.221	52.1	4.0	12.33	30.83
Humate + micro elements	56.6	0.248	53.9	2.7	13.90	34.75
LSD 05					0.13	

Comparing the studied variants, we can note some advantage of the mixture of all the studied fertilizers: the yield was 34.75 kg/m^2, the second place was the PABA variant – 33.93 kg/m^2 with the control value of 30.97 kg/m^2.

4 Conclusion

The obtained results of three turns showed that the use of pre-sowing seed soaking treatment and foliar fertilizing of plants with solutions of potassium humate and micronutrients, except lithium carbon dioxide, in the winter greenhouse contributes to plant growth in height, an increase in leaf surface area, and, as a consequence, a significant increase in the yield of cucumber fruits by 0.65-3.25 kg/m^2 with a control indicator of 30.75 kg/m^2. Lithium had a retarding effect on growth indicators, fruit formation, and their yield.

References

1. O.Yu. Abasheva, O.N. Krylov, Vegetables of Russia, **2(35)**, 92-96 (2017)
2. A.I. Asaliev, A.A. Belovolova, Physiology and biochemistry of plants: textbook, Stavropol: AGRUS, 136 (2006)
3. R.A. Gish, G.S. Gikalo, Vegetable growing in the South of Russia. Textbook, Krasnodar: "EDVI", 640 (2012)
4. E.E. Grigorai, G.N. Tabalenkova, I.V. Dalke, T.K. Golovko, Agrochemistry, **4**, 74-79 (2015)
5. A.S. Dzheliev, D.A. Cherdjiev, S.H. Dzanagov, Bulletin of scientific works of young scientists of the Gorsky State Agrarian University, **55/1**, 3-6 (2018)
6. S.H. Dzanagov, T.G. Nogaiti, D.A. Cherdjiev, Bulletin of the Gorsky State Agrarian University, **53(4)**, 28-37 (2016)
7. S.H. Dzanagov, D.A. Cherdjiev, A.S. Dzheliev, B.S. Kaloev, E.A. Tsagaraeva, R.V. Kalagova, Z.A. Kubatieva, Bulletin of the Gorsky State Agrarian University, **54(4)**, 21-24 (2017)
8. A.A. Dubovitsky, E.A. Klimentova, I. P. Barabash, et al., Training workshop on the discipline "Vegetable growing": a textbook for bachelor's degree training in the direction 110400 "Agronomy", StSAU, Stavropol: Paragraph, 108 (2013) (Gr. UMO)
9. B.I. Dukarevich, Fertilization of vegetable crops, Moscow: Rosagropromizdat, 78 (1990)
10. N.A. Kolpakov, Potatoes and vegetables, **3**, 8-10 (2013)

11. S. S. Litvinov, N. N. Klimenko, S. S. Arustamov, Potatoes and vegetables, **3**, 2-4 (2013)
12. S.M. Nadezhkin, E.V. Saldina, Potatoes and vegetables, **1**, 24 (2008)
13. A.E. Portyankin, A.V. Shamshina, Cucumber: from sowing to harvest, under the general editorship of S.F. Gavrish, Moscow: LLC "Hybrid seeds "Gavrish" for NP "NIIOZG", CJSC "Fiton+", 400 (2010)
14. N.V. Tuaeva, Selection of hybrids and development of technological methods to increase tomato productivity in winter greenhouses of RSO-Alania, Autoref. diss.... C.A.Sc. Vladikavkaz, 23 (2012)
15. T.B. Khadikova, S.H. Dzanagov, B.G. Tsugkiev, A.S. Kozaeva, Bulletin of the Gorsky State Agrarian University, **41**, 57-58 (2004)