

Effect of growth regulators on cucumber seed fertility

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Abstract. This scientific article places its emphasis on investigating the impact of biostimulants and growth-enhancing preparations on the germination of cucumber seeds in the context of intensive cucumber seedling cultivation. Our study encompasses a series of experimental and practical trials meticulously designed to elucidate the effects of various growth substances on the rapid and robust germination of cucumber seeds. Throughout the course of our experiment, we conducted comprehensive assessments of the process of treating cucumber seeds with a diverse array of growth stimulants. Our goal was to unveil the precise mechanisms through which these stimulants influence and expedite the germination process. By harnessing innovative technologies and implementing the most cutting-edge methodologies available, our research seeks to delve into the intricate dynamics of cucumber seedling cultivation under intensified conditions. One of the pivotal objectives of our study was to develop a strategic framework that enables the consistent production of high-quality cucumber seedlings. This endeavor involves the integration of advanced techniques and methodologies, aligned with the overarching aim of bolstering germination rates and cultivating robust cucumber seedlings. In essence, this research endeavor amalgamates experimentation, practical application, and the utilization of modern advancements to decipher the intricate interplay between biostimulants, growth preparations, and the germination process of cucumber seeds. By providing insights into these crucial facets, our study contributes to the refinement of intensive cucumber seedling cultivation practices, ultimately enhancing agricultural productivity and the quality of cucumber yields.

Keywords. Variety, hybrid, cucumber, seed, stimulant, germination, root, temperature, humidity.

1 Introduction

In the present era, the realm of vegetable seedling cultivation within our Republic is witnessing the emergence of novel categories of growth regulators [1]. These innovative growth substances are proving to be pivotal in revolutionizing agricultural practices [2]. Their integration into our agricultural landscape offers a multitude of benefits, including heightened seed germinability, enhanced seedling resilience in the face of adverse weather

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conditions, expedited seedling growth, amplified agricultural productivity, and the capacity to generate premium-grade, cost-effective, environmentally conscious produce [3, 4].

Our experiments have centered on the utilization of biopreparations, serving as a cornerstone in elevating seed germinability and fertility across a broad spectrum of agricultural crops [5]. This approach holds immense significance due to its widespread applicability, bolstering the resistance of seedlings against specific diseases and pests. This resilience enhancement not only contributes to improved plant health but also augments overall crop yield [6].

The integration of these innovative biopreparations constitutes a transformative force in the realm of modern agriculture [7]. By harnessing their potential, we pave the way for more robust and efficient agricultural practices that cater to both economic and environmental sustainability [8]. This shift towards growth regulators and biopreparations represents a remarkable stride towards a future where agricultural productivity is optimized, crop quality is elevated, and our environment is safeguarded. In the world, special attention is being paid to the organization of a healthy diet that provides the need for daily consumption of vegetables [9-11].

Among vegetables, cucumber is one of the main crops, and it is expedient to increase the volume of its cultivation and improve the quality of the product [12]. The total area planted with cucumbers in the world is 2 mln 496 thous. hectares, and the gross production volume is 91.3 million tons. China (65 million tons), Iran (1.981.000 tons), Russia (1.940.000 tons), Turkey (1.827.000 tons) and the United States (956.000 tons) are among the leading countries in terms of gross product volume [13-15].

2 Materials and methods

Currently, the demand to increase the production of cucumbers is increasing. Therefore, increasing its productivity in the leading cucumber-growing countries remains an urgent task. In our country, in 2022, cucumber cultivated area was more than 25.000 hectares, and the total volume of production was more than 853.100 tons. It means that it can fully meet the demand of the population of the country [15]. However, the increase in the number of population and the expansion of the volume of product exports lead to an increase in the demand for this product [7, 8]. Therefore, it is necessary to create new, high-yielding varieties of cucumber and to develop innovative technological elements of growing cucumbers in the open field.

During field experiments in research, phenological observations, biometric measurements, monitorings on the rapid germination of cucumber seeds were carried out. Observations and calculation records were carried out in accordance with generally accepted requirements. Experiments were done in 4 replications.

The research and its experiments were carried out in 2019-2022 in 100 m² area of protected facility of the Information and Consulting Center of Tashkent State Agrarian University. The purpose of the research is to determine the effect of biostimulants on the germination of seeds, its optimal application rate and periods in the cultivation of cucumber seedlings. The object of research is cucumber variety "Sevinch", "Fantina" G1, "Superina" F1 and "Beyt-Alfa" F1 hybrids and PLANTASTIM, Zerebra-Agro and Ifo Seed biostimulants.

3 Results and discussion

The results of research. For our experiments, we selected varieties and hybrids that are suitable for cultivation of cucumbers by the trellis method. "Sevinch" variety of cucumber

created by the co-authorship and hybrids "Fantina" G1, "Superina" F1 and "Beyt-Alfa" F1 brought from foreign countries, which are suitable for the soil and climate conditions of our republic were used in the experiments. As we all know that vegetable seeds are mainly sown directly in the open field after soaked in water or in dry form. We observed that cucumber seeds are planted in the field after being soaked in water for a certain period of time, and it is noted in scientific sources that when unsoaked seeds are planted, their germination coefficient is different compared to those that have been water-soaked. Therefore, in our experiments, we studied the effect of several biostimulants on increasing seed germination by treating seeds with them and certain results were obtained. In our experiments, control option was prepared by treating cucumber seeds in normal clean water (H₂O). In other variants under study, currently recommended PLANTASTIM, Zerebra-Agro and Ifo Seed biostimulants were used.

Before sowing, the seeds were soaked in clean water and PLANTASTIM, Zerebra-Agro and Ifo Seed substances for 5 hours, then in a special heating place (heated floor), the seeds were spread on gauze or simple fabric and treated for 24 hours. If you carefully observe the processed seeds, you can notice that they are ready to germinate at the tip. After that, the seeds were sown in special cassettes or substrates prepared in cups. Germination of seeds was observed 1-2 days after sowing. After the seeds germinated fully, 2 days before transplanting in the open field, a suspension of growth regulators was prepared and applied by spraying once through the leaves.

The degree of germination of the seeds of "Sevinch" variety, "Fantina" G1, "Superina" F1 and "Beyt-Alfa" F1 hybrids under the influence of these growth preparations was determined in our experiments. It can be said that when cucumber seeds were sown in dry form without any treatment or soaked in water have lower germination rate, on the contrary when they were treated with certain biostimulants the germination rate of seeds was observed to be higher. At the same time, after germination of the seeds, intensive development of root system and soil surface part of the plant, its stem growth and leaves were observed.

The conducted experiments showed that compared to the control option, i.e. the case of cucumber seeds treated in water, the germination of the seeds treated with the preparations, the healthy development of the seedlings, and their viability in the open field were observed to be higher in our experiments. Considering above-mentioned results, it can be said that the use of modern preparations in the rapid cultivation of cucumber seedlings is expedient (Tables 1).

Table 1. Effects of types of growth regulators on the germination of cucumber seeds (in 2019-2022).

| Varieties | Type of biostimulant | Soaking period (hours) | Treatment period (hours) | Root formation (day) | Germination (day) | Formation of true leaves (day) |
|------------|--------------------------------|------------------------|--------------------------|----------------------|-------------------|--------------------------------|
| Fantina F1 | Treatment with water (control) | 5 | 24 | 4 | 6 | 10 |
| | ZEREBRA AGRO | 5 | 24 | 3 | 5 | 9 |
| | PLANTASTIM | 5 | 24 | 2 | 4 | 8 |
| | IFO SEED | 5 | 24 | 2 | 4 | 8 |
| | LSD ₀₅ | 0.5 | 0.4 | 0.3 | 0.5 | 0.6 |

| | | | | | | |
|----------------------|-----------------------------------|-----|-----|-----|-----|-----|
| Superina F1 | Treatment with water (control) | 5 | 24 | 4 | 6 | 10 |
| | ZEREBRA AGRO | 5 | 24 | 3 | 5 | 9 |
| | PLANTASTIM | 5 | 24 | 2 | 4 | 8 |
| | IFO SEED | 5 | 24 | 2 | 4 | 8 |
| | LSD ₀₅ | 0.3 | 0.5 | 0.3 | 0.3 | 0.4 |
| Beyt-Alfa F1 | Treatment with water (control) | 5 | 24 | 3-4 | 6 | 10 |
| | ZEREBRA AGRO | 5 | 24 | 2-3 | 5 | 9 |
| | PLANTASTIM | 5 | 24 | 2 | 3 | 7 |
| | IFO SEED | 5 | 24 | 2 | 4 | 8 |
| | LSD ₀₅ | 0.3 | 0.2 | 0.3 | 0.5 | 0.4 |
| "Sevinch" variety | Treatment with water (control) | 5 | 24 | 4 | 6 | 10 |
| | ZEREBRA AGRO | 5 | 24 | 3 | 5 | 9 |
| | PLANTASTIM | 5 | 24 | 2 | 3 | 7 |
| | IFO SEED | 5 | 24 | 2 | 4 | 8 |
| | LSD ₀₅ | 0.4 | 0.3 | 0.3 | 0.5 | 0.4 |

We can see in the table that when the cucumber varieties were processed, their seed germination increased. It was found that when the varieties and hybrids of cucumbers selected as control and were treated with water and other varieties treated with preparations in the same way, their germination, formation of the root system, formation of leaves differed from each other. In the control option, that is, when the seeds treated with water, the germination of seeds of varieties and hybrids showed almost the same result, as a result of the applied preparations, the germination of seeds, proliferation of roots and the above-ground part and formation of true leaves of some varieties were observed to change significantly compared to the control. In the experiments, when all varieties of cucumbers were treated with water, the seeds were soaked in water for 5 days. After that, it was spread on a cloth or gauze in a warm place and sprayed with water for 24 hours. After the tips of the water-saturated seeds were ready to germinate, they were sown individually on glass substrates. This agrotechnical measure of seed treatment was carried out in the same way in all varieties and the preparations were applied in the same process in our experiments. The result, as noted in the table, when the seeds treated with ZEREBRA AGRO preparation, compared to the control (water), the appearance of roots was observed one day earlier. It took 6 days for the seeds to germinate on the surface of the soil, and the appearance of true leaves was observed 10 days after sowing.

In the experiments, it was found that PLANTASTIM and IFO SEED preparations had a positive effect on the germination of cucumber seeds. Planting of cucumber seeds after soaking them in water mixed with PLANTASTIM biostimulant for 4-5 hours (10 ml per 1 liter of non-chlorinated water) or planting the seedlings of cucumber in cups and cassettes after treating with PLANTASTIM mixture (150 ml per 10 liters of non-chlorinated water) showed good results. At the same time, as a result of treatments on cucumber seeds, the viability and proliferation of seedlings, develop of their immunity against root rot, and vigorously formed vegetative organs, and a positive effect on high productivity were also

observed during our subsequent experiments. As a result of treatment of the seeds of the cucumbers varieties and hybrids used in our experiments, it was observed that the germination of the seeds of the Fantina F1 cucumber hybrid was slightly less developed compared to other varieties and hybrids (Figure 1).

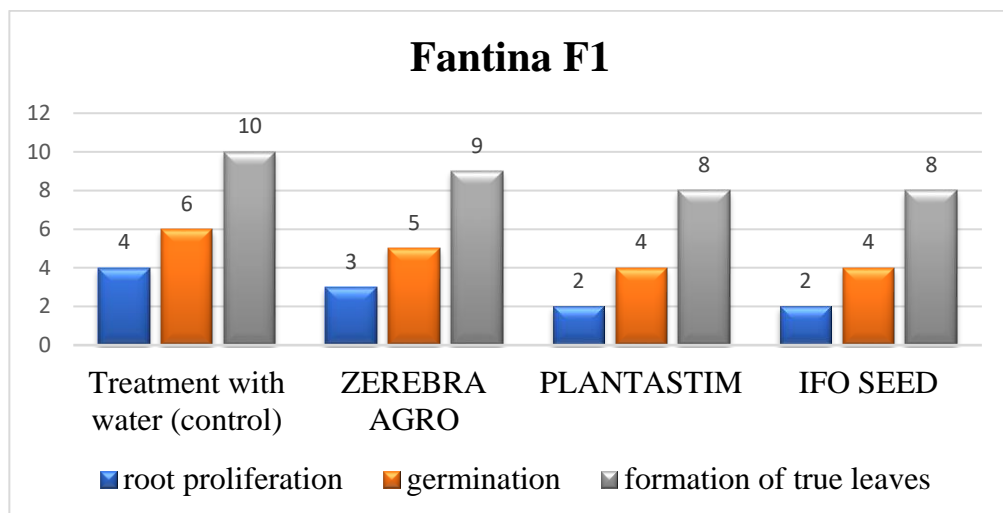


Figure 1. Rate of germinability of seeds and development of vegetative parts of Fantina F1 hybrids after treating its seeds with water, Zerebra-agro, PLANTASTIM and IFO-seed preparations.

It can be seen that when Fantina F1 hybrid seeds were treated in water, the formation of the initial root system took place on the 4th day of sowing, the germination of the seeds took place on the 6th day, and the formation of true leaves took place after 10 days.

When Fantina F1 hybrid seeds were treated with Zerebra-agro biostimulant, it was observed that the initial root system formation occurred on the 3rd day, seed germination occurred on the 5th day, and the formation of true leaves occurred after 9 days from the planting.

When the seeds were treated with the PLANTASTIM biostimulant, the formation of the first roots was observed on the 2nd day, the germination of the seeds was observed on the 3rd day, and the formation of true leaves was observed on the 8th day of the planting. When the seeds were treated with IFO SEED, their development was observed as follows: it was found that the formation of the root system began on the 2nd day, the germination of seeds began on the 3rd day, and the formation of true leaves began on the 8th day from the planting.

From this, it can be said that PLANTASTIM biostimulant and IFO SEED growth preparation showed a good effect on the germination of Fantina F1 hybrid seeds, the formation of root system and the formation of true leaves compared to the control (water).

During our experiments, the effect of the applied preparations on the germination of the seeds of the Superina F1 hybrid of cucumber was differentiated as follows: initially, as a control, when the seeds were treated in water, the result observed in the Fantina F1 hybrid was recorded. Also the effect of preparation types was observed in this variety. When Superina F1 hybrid seeds were treated with Zerebra-agro biostimulant, the formation of the initial root system was observed from the 3rd day, and the germination of the above-ground part of the seeds began from the 5th day. It was observed that the formation of true leaves occurred after 9 days from the sowing.

When the seeds of this hybrid were treated with PLANTASTIM biostimulant, the formation of the root system and the number of roots was observed to be higher from the 2nd

day, and rapid germination of the seeds was observed on the 3rd day. It was found that the formation of true leaves developed from the 8th day. The effect of IFO SEED from the used preparations was as follows when treated on seeds compared to the control. It was observed that the formation of the root system of the seeds developed on the 2nd day, the germination of the surface part of the plant on the 3rd day, and the formation of true leaves from the 8th day of the planting (Figure 2).

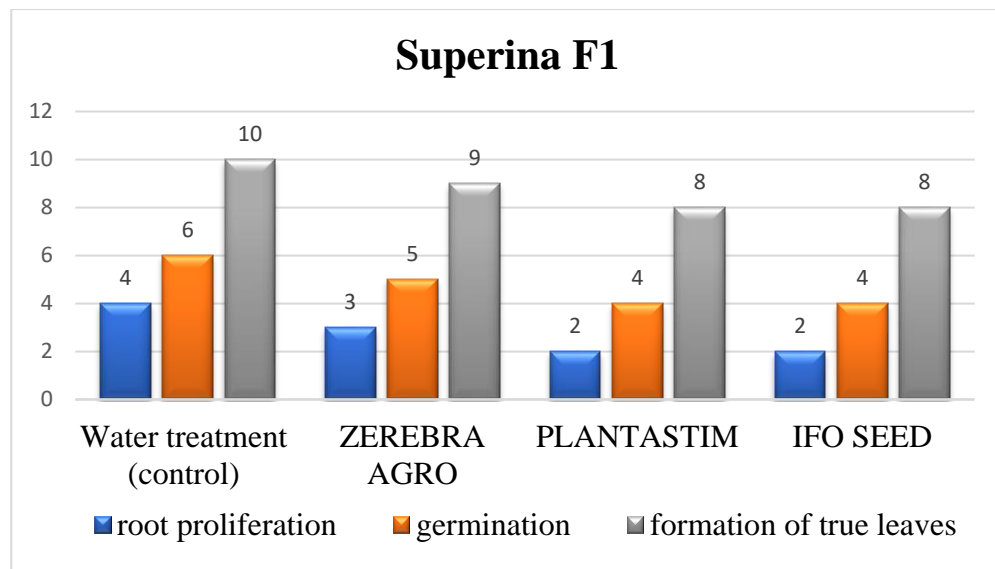


Figure 2. Rate of germinability of seeds and development of vegetative parts of Superina F1 hybrids after treating its seeds with water, Zerebra-agro, PLANTASTIM and IFO-seed preparations.

Seed germination, formation of root system and emergence of true leaves of the Superina F1 hybrid were observed to have good results with the treatment of PLANTASTIM biostimulant and IFO SEED preparation compared to control (water) and Zerebra-agro stimulant. It can be said that when vegetable seeds, including cucumber seeds, are treated with these preparations, it was found during phenological observations in our experiments that the fertility coefficient of seeds increases and, at the same time, the continued viability of seedlings and their resistance to adverse conditions are ensured.

In our experiments, it was observed that the following results were recorded when the seeds of the studied cucumber Beyt-Alfa F1 hybrid were treated with the above preparations (Figure 3). Experiments have shown that stimulators and preparations are directly important for the germination of cucumber seeds and the continued viability of seedlings and this was proven also by our phenological observations.

We observed the following effects on cucumber Beyt-Alfa F1 hybrid seeds: when the seeds were treated with water, it was found that the germination of the seeds was the same as the above varieties, but when we treated them with stimulants and preparations, the germination of the seeds and the rapid development of vegetative organs were observed. When the seeds were treated with the Zerebra-agro stimulant, the formation of their root system appeared on the 3rd day, and the initial germination of the seeds was observed on the 5th day. During our experiments, we observed that true leaves were formed 8 days after sowing the seeds.

When the seeds of this hybrid were treated with PLANTASTIM biostimulants, it was observed that the root system was strongly formed and the number of roots increased

significantly compared to the roots of the above hybrids. It can be concluded that PLANTASTIM biostimulant has a positive effect on the fertility of Beyt-Alfa F1 hybrid seeds. The root system was formed from the 2nd day after the treatment of the seeds, rapid germination of the seeds was observed on the 3rd day. It was observed that the formation of true leaves developed from the 7th day. It can be seen during our experiments that this stimulant had a positive effect on the formation of leaves in the seedlings and the appearance of leaves 3 days earlier compared to the control (water).

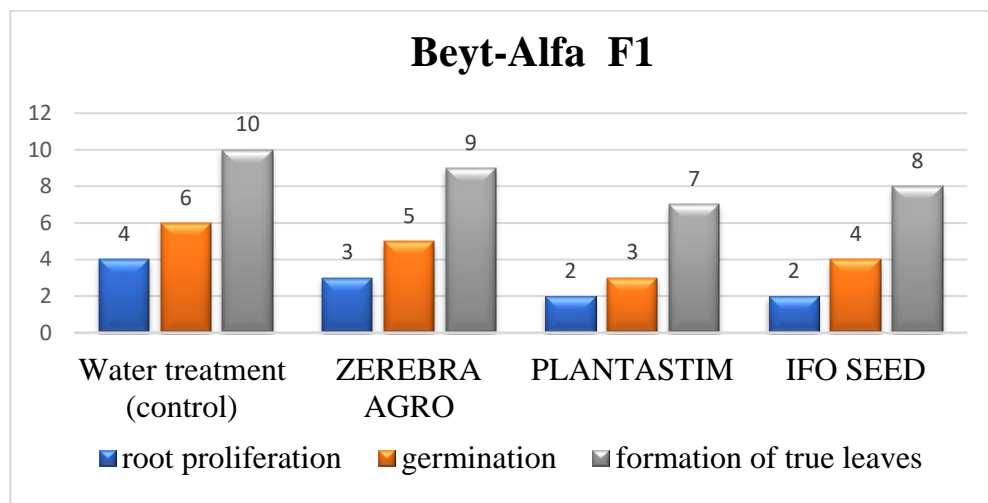


Figure 3. Rate of germinability of seeds and development of vegetative parts of Beyt-AlfaF1 hybrid after treating its seeds with water, Zerebra-agro, PLANTASTIM and IFO-seed preparations.

The Beyt-Alfa F1 hybrid seeds of cucumber showed faster germination in stimulants and preparations compared to other studied hybrids. It is under the influence of these stimulants and preparations that the biochemical processes in the seed are accelerated and the seed sprout quickly wakes up, as a result, the primary root is formed from the sprout and the seed germination is high. Therefore, in today's modern agriculture, it is an important task to quickly increase the germination of vegetable seeds and prepare healthy quality vegetable seedlings in a short period of time. Biostimulants and preparations that we use in our experiments serve as an important object in this regard. During our experiments, in addition to studying the fertility of hybrid seeds brought from foreign countries, we also tested in our research the fertility of the seeds of the Sevinch variety, created in co-authorship. It is necessary to mention that the Sevinch variety of cucumber is suitable for cultivation in the open field by the trellis method. When the seeds of this Sevinch variety were treated with stimulants and preparations, their germination was observed as follows (Figure 4).

Although the seeds of this variety showed the same results as the above hybrids when treated in water, the influence and effectiveness of stimulants and preparations were found to have better results. When the seeds were treated with the Zerebra-agro stimulant, the formation of their root system was observed on the 3rd day after sowing the seeds. The germination of seeds was observed on the 5th day, and the formation of true leaves was observed on the 8th day. During our experiments, it was found that the biochemical processes in the seeds accelerated when the seeds were treated with the PLANTASTIM stimulant. During the phenological observations, we were sure about the rapid development of seedlings and germination in the seeds compared to the control.

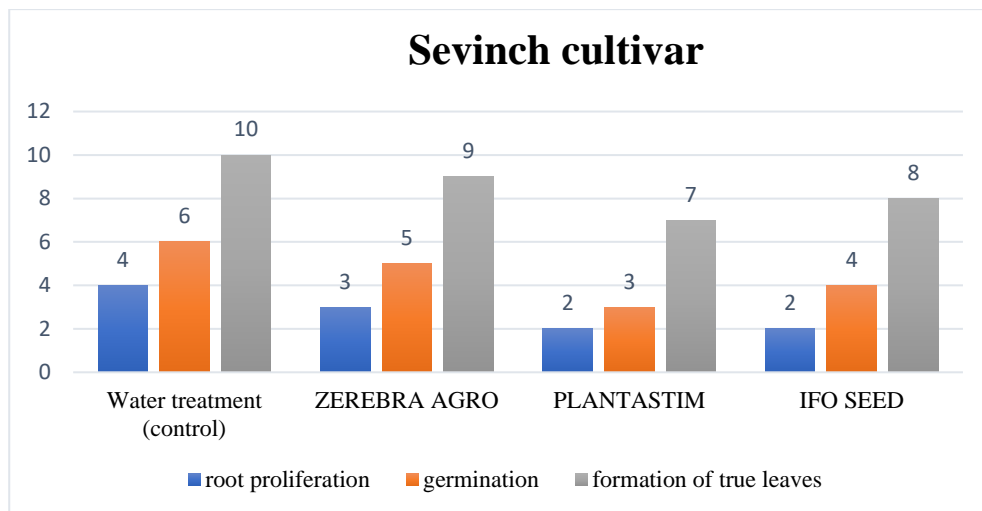


Figure 4. Rate of germinability of seeds and development of vegetative parts of Sevinch variety after treating its seeds with water, Zerebra-agro, PLANTASTIM and IFO-seed preparations.

While we observed in our experiments that PLANTASTIM stimulant had a positive effect on seed fertility in all studied hybrids, but it was observed that the PLANTASTIM stimulant had a better effect especially on the seed fertility of Beyt-Alfa F1 hybrid and Sevinch variety than other hybrids. We can say that the PLANTASTIM stimulant showed an advantage effects over other types of stimulants and preparations used in our experiments on the germination of cucumber seeds (Figure 5).

Experiments have shown that 10-day-old seedlings of Sevinch cucumber seeds treated with water are much smaller and weaker than 7-day-old seedlings of seeds treated with PLANTASTIM stimulant, as can be seen from the figure below.



Figure 5. a) Status of 10-day-old seedlings of Sevinch variety seeds treated in water, b) Status of 7-day-old seedlings of Sevinch variety seeds treated with PLANTASTIM stimulant.

It was observed during our experiments that when cucumber seeds were treated with the PLANTASTIM stimulant, the seedlings developed 3 days earlier than the control and strong healthy seedlings were ready. All experiments were carried out in protected facilities. The

effect of stimulants and preparations used during our experiments on the germination of seeds of cucumber varieties and hybrids was studied. At the same time, we have observed in our experiments that certain objects (types of substrate) and the temperature, relative humidity of the air in the facility can affect the seed germination and their norms are important for the intensive germination of seeds.

4 Conclusions

Through our meticulously designed experiments, we made a significant revelation: the applications of PLANTASTIM and IFO SEED preparations yielded highly favorable outcomes in the germination process of all cucumber varieties and hybrids studied. This breakthrough holds profound implications for the cultivation of cucumber crops.

Notably, within the realm of cucumber varieties, the Beyt-Alfa F1 hybrid and the Sevinch variety stood out as exemplars of successful seed germination under the influence of these stimulants. This observation underscores the potency of PLANTASTIM and IFO SEED in promoting optimal germination rates, with these particular cucumber variants displaying remarkable receptivity to the effects of these growth-enhancing preparations.

These findings carry great significance as they offer a practical means to enhance the germination process and potentially bolster the overall success of cucumber cultivation endeavors. By identifying specific varieties and hybrids that respond particularly well to these stimulants, we lay the foundation for tailored agricultural strategies that maximize crop yield and quality. Such discoveries further underscore the potential of innovative growth enhancers in revolutionizing agricultural practices and contributing to sustainable, high-yield food production.

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