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EFFECTS OF SOME APPLICATIONS ON STRAWBERRY SEEDLING PRODUCTIVITY AND QUALITY

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Abstract
Strawberry is one of the important berries grown widely in the world. In parallel with the increase in strawberry production, the need for quality strawberry seedlings also increases. This study was carried out on the Kabarla strawberry variety. The study investigated the effect of 4 treatments (Control, Glycine + Humic acid, Glycine + IBA, Humic acid + IBA) on strawberry seedling production. The study was designed according to the randomized block trial design with three replications for each application and six plants in each replication. Strawberry seedlings were planted in the first week of May, spacing 50 cm x 1 m. Applications were carried out 4 times with an interval of 15 days when the first stolons on the plants were ready for rooting. Seedlings were divided into three quality groups: A+, A, and B. At the end of the study, it was determined that all applications positively affected the number and quality of strawberry seedlings. While the Humic acid + IBA application was found to be the most effective application to obtain A+ quality seedlings, the Glycine + IBA application was found to be the most effective application to obtain A and B quality seedlings.

Keywords: Strawberry seedling, humic acid, glycine, IBA

1. INTRODUCTION

Strawberry (Fragaria x ananassa Duch), one of the important berry fruit species, belongs to the Fragaria genus of the Rosaceae family of the Rosales order. Strawberry, a temperate climate fruit species, is a berry fruit that can be grown almost everywhere in the world within wide ecological boundaries from Ecuador to Siberia due to its high adaptability, is consumed by everyone, and has a great market advantage as fresh and industrialized (Amil-Ruiz et al., 2011).

Strawberry production is increasing day by day due to reasons such as being available in the market in months when there are no fruit species in the market, being used in the food industry such as jam, marmalade, cake, ice cream and fruit dairy products in addition to fresh consumption, being suitable for small family businesses, being grown in hillside and sloping mountain villages and being able to recover investment costs in a short time (Gündüz and Özdemir, 2010). Strawberries, whose production is increasing daily, contain minerals and vitamins important for human health and nutrition, such as salicylic acid, calcium, iron and phosphorus. Interest in strawberries, which contain compounds important for human health and nutrition, is increasing rapidly daily (Ertürk et al., 2017). While 9,064,345 tons of strawberries were produced worldwide in 2020, 10,485,454 tons of strawberries were produced in 2023 (FAOSTAT). In parallel with the increase in strawberry cultivation, the need for seedlings also increases. Seed, stolon, underground stems and tissue culture

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techniques are used to obtain strawberry seedlings. The most common commercial seedling production technique is the production method using stolons. The effect of quality strawberry seedlings on both seedling formation and product yield has been demonstrated in previous studies. Seedlings obtained from high altitude regions are superior to seedlings obtained from low altitude regions in terms of earliness, seedling development, productivity and quality characteristics. This situation can be attributed to the seedlings accumulating more carbohydrates due to intense lighting (Kaşka et al. 1986; Türemiş and Kaşka 1993; Savini et al., 2005).
Considering all these issues, the' high yield and quality of strawberries depend on the quality of strawberry seedlings. Studies on commercially produced strawberry varieties focus mainly on fruit quality and yield. However, there are few studies on the production of quality strawberry seedlings. This study investigated the effects of Glycine + Humic acid, Glycine + IBA and Humic acid + IBA applications on strawberry seedling production.

2. MATERIALS AND METHODS

The Kabarla strawberry variety was used as the study material. Before planting seedlings, 15-15-15 (N-P-K) chemical fertilizer was applied as base fertilizer at 50 kg per decare. Strawberry seedlings were planted in the first week of May with a distance of 50 cm X 1 m between rows. Applications (Glycine + Humic acid, Glycine + IBA, Humic acid + IBA) to the plants planted at the beginning of May were carried out regularly 4 times at 15-day intervals, starting from the beginning of July (when the first stolons were ready to root). Within the scope of the study, the total number of seedlings, the number of seedlings per main plant and the number of seedlings per square meter were determined. In addition, the obtained seedlings were divided into three classes according to stem diameter measurements. The stem diameter of the seedlings was grouped as >1.6 cm as class A+, 1.0-1.6 cm as class A and <1 cm as class B.
The study was designed according to the randomized block trial design with three replications of 6 plants for each application. Differences between the means were compared with the Tukey test at the 0.05 significance level in the JMP Pro 17 statistical package program.

3. RESULTS AND DISCUSSIONS

As a result of the study, the effects of the applications on seedling numbers and seedling classes were found to be statistically significant (Table 1). The total number of seedlings showed the highest values in the Humic Acid + IBA application (60.00) for the A+ seedling class and in the Glycine + IBA application (370.00 and 780.00, respectively) for the A and B group seedling classes. The highest values for the number of seedlings per mother plant were determined in the Humic Acid + IBA application for the A+ seedling class (10.00) and in the Glycine + IBA application for the A and B group seedling classes (61.66 and 130.00, respectively), while the number of seedlings per square meter was determined in the Humic Acid + IBA application for the A+ seedling class (5.00) and in the Glycine + IBA application for the A and B group seedling classes (30.83 and 65.00, respectively). Indole Butyric Acid (IBA), which is widely used in rooting plants, has a sustained effect on rooting (Zhang et al., 2004). Humic acid increases plant nutrient uptake (De Kock, 1955; Cooper et al., 1998) and ensures plants' resistance to different stress conditions (Nardi et al., 2002). In addition, humic acid increases cell membrane permeability, root cell size, photosynthesis and respiration efficiency, and oxygen and phosphorus uptake (Türkmen et al., 2004). Within the scope of the study, the most effective application for obtaining an A+ seedling class is the application of humic acid, and this can be attributed to the positive effects of humic acid on the nutrient uptake of plants. Our study results

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are similar to the positive effects of different applications on strawberry seedling production in the literature. It has been reported that organic fertilizer applications (Iğdırlı and Türemiş, 2008), humic acid and bacteria applications (Pehluvan and Güleryüz, 2014) and commercial fertilizer and liquid worm compost applications (Gerçekcioğlu and Bektaş, 2022) are more successful in strawberry seedling production compared to the control application.

The number of stems in strawberries is effective in the formation of high quality and productive seedlings. The thickness of the stem diameter in strawberries is important for good nutrition and development of seedlings. However, while increasing the number of stems is desired in seedling cultivation, increasing the number of stolons in strawberries reduces the number of stems (Gerçekcioğlu and Bektaş, 2022). In our study results, it can be said that the positive effect of humic acid + IBA application on obtaining quality seedlings prevented the negative effect on the increase in the number of stolons, which is important in the formation of strawberry seedlings. It is known that humic acid increases root and vegetative development by accumulating suitable nutrient elements in the root zones of different plant species such as forage crops (Cooper et al., 1998), mushrooms (Padem et al., 1999) and tomatoes (Hoang Thi Lua and Böhme, 2001).

Table 1. Total seedling number, seedling number per mother plant, and seedling number per square meter of different treatments in the Kabarla strawberry variety

Traits	Treatments	A+	A	B	Mean
Total Number of Seedlings (Piece)	Control	20.00 f	174.00 e	440.00 c	211.33 d
	Glisin + Humik Asit	54.00 f	300.00 d	690.00 a	348.00 b
	Glisin + IBA	56.00 f	370.00 cd	780.00 a	402.00 a
	Humik Asit + IBA	60.00 f	310.00 d	540.00 b	303.33 c
	Mean	47.50 c	288.50 b	612.50 a	-
Number of Seedlings per Main Plant (Piece)	Control	3.33 f	29.00 e	73.33 c	35.22 d
	Glisin+Humik Asit	9.00 f	50.00 d	115.00 a	58.00 b
	Glisin + IBA	9.33 f	61.66 cd	130.00 a	67.00 a
	Humik Asit + IBA	10.00 f	51.66 d	90.00 b	50.55 c
	Mean	7.91 c	48.08 b	102.08 a	-
Number of Seedlings per Square Meter (Piece)	Control	1.66 f	14.50 e	36.66 c	17.61 d
	Glisin+Humik Asit	4.50 f	25.00 d	57.50 a	29.00 b
	Glisin + IBA	4.66 f	30.83 cd	65.00 a	33.50 a
	Humik Asit + IBA	5.00 f	25.83 d	45.00 b	25.27 c
	Mean	3.95 c	24.04 b	51.04 a	-

4. CONCLUSIONS

As a result of the study, it was observed that Humic Acid + IBA application had a positive effect on the number of quality seedlings, while Glycine + IBA application had a positive effect on the number of seedlings rather than the quality of seedlings. Considering that quality and efficient fruit production in strawberry cultivation depends on seedling quality, it was concluded that Humic Acid + IBA application was significantly effective for seedling cultivation in strawberries.It was concluded that Humic Acid + IBA application was significantly effective for seedling cultivation in strawberries.

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