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The Effects of Different GA_3 and Mycorrhiza Dosages on Mini Tuber Production in Potatoes

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ABSTRACT

This study was conducted in 2017 under greenhouse conditions using selected four different potato clones to determine the effects of different doses of GA_3 and arbuscular mycorrhizal fungus on mini tuber production. The research, carried out in a randomized complete block design with three replications, applied GA_3 doses of 0, 5, 10, and 15 ppm, and mycorrhizal inoculat doses of 0, 500, 1250, and 2000 mg/100 tubers. Parameters including emergence time, plant height, main stem number, tuber number, average tuber weight, tuber size distribution (>45 mm, 28-45 mm, <28 mm), and maturity period were examined. The effect of GA3 application on all investigated parameters except the number of main stems was significant, statistically. The highest mini tuber number (9.1 tubers) and mini tuber yield (408.4 g/pot) were obtained from the application of 15 ppm GA_3, while the highest average mini tuber weight (46.74 g) was obtained from the control group. In mycorrhizal applications, the highest tuber number was obtained at a dose of 500 mg/100 tubers, and the highest mini tuber weight and yield were obtained at a dose of 1250 mg/100 tubers. As a result of the study, it was determined that the application of 15 ppm GA_3 is suitable due to its positive effect on mini tuber multiplication, and the mycorrhizal application at a dose of 500 mg/100 tubers is appropriate due to its positive effect on increase of tuber number.

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Introduction

Potato (*Solanum tuberosum* L.) holds significant importance worldwide as a staple food in terms of consumption and production quantity (Demirel et al., 2020). The first potato cultivation is reported to have taken place approximately 6000 years ago in the Andes mountains of America (Öztürk and Polat, 2017). In Europe, potato cultivation began in Ireland from the 18th century onwards (Laçin, 2018). Nowadays, potato cultivation is widespread in numerous countries (Vincent et al., 2013). The ability of potatoes to adapt well to different environments, provide high yields, possess processing characteristics, offer dietary diversity, and serve as a nutritious food source has contributed to its widespread cultivation from ancient times to the present. Besides being a rich source of carbohydrates and starch, potatoes are also abundant in various minerals and vitamins, including calcium. Potatoes are propagated through their tubers. Due to the importance of producing seed potatoes under controlled and sterile conditions to ensure disease-free and desired seed characteristics, controlled multiplication of basic seed potatoes is crucial (Jones, 1988; Struik and Lommen, 1990; Lommen, 1995). Meristem culture is utilized in potato seed production to obtain virus-free and healthier plants. Subsequently, mini tubers are obtained under controlled greenhouse conditions (Bryan, 1988; Yıldırım, 1995). The use of suitable environments for the multiplication of mini tubers under greenhouse conditions is essential. Apart from aerophonic or hydroponic methods, various substrates such as perlite, peat, sand, and different organic material mixtures are used as propagation media (Kaur et al., 2000). In potato seed production, it has been indicated that controlled conditions are more suitable for producing elite seed potatoes, which are the original seed class, in terms of tuber yield and multiplication compared to open-field conditions (Yılmaz et al., 2018). Gibberellins are plant growth regulators obtained from Gibberella fujikuroi fungi (Seçer, 1989). GA_3 is the most commonly used form of these in agriculture, known for its properties to promote seed germination and break dormancy (Olszewski et al., 2002; Tyler et al., 2004). Gibberellic acids are substances belonging to the class of hormones that promote plant growth and development (Aslantaş, 2012). Beneficial fungi are used in agricultural production for nutrition and plant protection purposes (Bhandari, 2021). Mycorrhizal fungi have two different types: endo- and ectomycorrhizae (Bonello, 2001). Endomycorrhizae

support plant growth in nutrient-poor soils. By forming a symbiotic relationship with plant roots, they improve the uptake of necessary nutrients from the soil. Through mutually beneficial biotic interactions, mycorrhizae obtain carbon from the plant while making the plant more efficient in using water and nutrients located far from the root zone (Mitra et al., 2020). Mycorrhizal fungi enhance plant resistance to drought, salinity, and heavy metal stress (Tisdall, 1994). Additionally, mycorrhizal fungi act as protective biological agents against pathogens by establishing a symbiotic life with the plant (Himaya, 2021). This study was conducted to determine the effects of different doses of GA_3 and Arbuscular Mycorrhizal fungi on potato development. The research was planned to propagate mini tubers obtained from meristem culture of the clones with good characteristics, namely 7/12, 3/110, 6/28, and 10/15, developed within the framework of the TÜBİTAK-TOVAG 214O115 project, and to obtain seed tubers necessary for different location trials to be established later. Clone number 6/28 used in the study was registered under the name GÜNGÖRBEY by the General Directorate of Seed Registration and Certification of the Ministry of Agriculture and Forestry of the Republic of Turkey on 06.04.2022, and it took its place in the National Variety List (Anonymous, 2024). This research was conducted in the polycarbonate greenhouses of the Department of Field Crops, Faculty of Agriculture, Gaziosmanpaşa University, in pot trials. The effects of different doses of mycorrhiza and gibberellic acid on the multiplication of mini tubers of selected clones were examined, and it was aimed to determine their effects on plant growth, tuber count, tuber size, tuber yield, and especially tuber multiplication rates in tubers planted in pots.

Materials and Methods

This study was conducted in 2017 following a randomized complete block design with three replications. The genotypes named 3/110, 6/28, 7/12 and 10/15 selected in our study were assigned to main plots, while different doses of GA_3 and mycorrhiza were assigned to subplots. Four different doses of GA_3 (0, 5, 10, and 15 ppm) and four different doses of mycorrhizal fungus (0, 500, 1250, and 2000 mg/100 tubers) were investigated. Trials containing GA_3 and mycorrhizal fungus were conducted separately in two different experimental setups. The mycorrhizal fungus Glamus spp. was used in the study. The mycorrhizal fungus used is commercially named shubhodayo and the microorganism name in its content is *Glomus proliferum*. The specified mycorrhiza doses were mixed with 375 ml of water, and 1 drop of spreader-sticker was added to the mixture. Mini tubers were immersed in the prepared solution for 1 minute and then immediately planted without exposure to sunlight. Observations and measurements conducted in this study, and the subsequent data acquisition and evaluation, were based on the methodologies outlined by Yılmaz (1993), Özkaynak and Samancı (2002), Karaat (2011), Yılmaz et al. (2014), and Karan and Yılmaz (2016). The obtained results were statistically analyzed using variance analysis according to the experimental design. The means of the results were compared using the Duncan multiple range test (Yurtsever, 1984).

Results and Discussion

Emergence Time (days)

The effect of different doses of GA_3 and mycorrhiza on emergence time is presented in Table 1. The emergence time ranged from 27.8 to 32.3 days with GA_3 application and from 26.56 to 29.83 days with mycorrhiza application. According to Table 1, while GA_3 application was statistically significant at the 1% level, mycorrhiza application did not create a statistically significant difference. The earliest emergence was achieved in the control group (0 ppm) with GA_3 application, followed by the second earliest emergence from the 15 ppm GA_3 dose. The 5 and 10 ppm GA_3 applications were statistically in the same group. In some cases, GA_3 application is known to cause secondary dormancy (Yılmaz, 2016). The average emergence time for the clones treated with GA_3 ranged from 19.0 to 40.5 days, with statistically significant differences observed. The clone with the earliest emergence was 6/28, followed by 10/15, 3/110 and 7/12 in order (Table 2). Similar to GA_3 applications, differences in emergence time were statistically significant in mycorrhiza applications as well. The average emergence time for clones ranged from 16 to 41.0 days. The clone with the earliest emergence was 6/28, followed by 10/15, 3/110, and 7/12 in order. In both GA_3 and mycorrhiza applications, the emergence time of clones in the control group varied, with clone 3/110 ranging from 30 to 35 days, clone 6/28 ranging from 16.25 to 19.0 days, clone 7/12 at 40.5 days, and clone 10/15 ranging from 26.25 to 27.5 days.

Table 1. The effect of GA3 and Mycorrhiza applications on plant yield parameters in mini tuber production of potato.

	ET	PH	MSC	TC	ATW	TY	Tuber Size Distribution			MP
							>45 mm	28-45 mm	<28mm >	
GA_3 Dosages										
0 ppm	27.8b	91.83a	1.40*	8.9a	46.74a	402.5a	34.49ab	27.34a	36.78b	122.8b
5 ppm	31.5a	68.64c	1.40	6.7b	39.23ab	275.8c	29.98b	17.00b	53.02a	124.5a
10 ppm	32.3a	76.00bc	1.10	8.7a	38.45b	361.5b	32.26b	16.89b	50.85a	124.5a
15 ppm	29.5ab	77.78b	1.40	9.1a	46.30ab	408.4a	42.50a	19.48ab	37.53b	124.5a
Mycorrhizal Dosages										
0 (mg/100 tuber)	26.56*	91.38b	1.4*	8.90bc	47.57a	402.0ab	36.74ab	26.49*	36.78*	122.8a
500 (mg/100 tuber)	29.83	99.11ab	1.4	11.10a	34.04b	369.1ab	31.36b	26.28	42.41	117.5b
1250 (mg/100 tuber)	27.17	97.86ab	1.2	8.40c	52.61a	403.3a	42.44a	19.18	38.38	117.5b
2000 (mg/100 tuber)	27.72	100.60a	1.2	10.10ab	39.01b	365.9b	39.10ab	27.07	33.83	117.5b

ET: Emergence Time (days); PH: Plant Height (cm); MSC: Main Stem Count (pieces); TC: Tuber Count (pieces); ATW: Average Tuber Weight (g); TY: Tuber Yield (g pot^{-1}); MP: Maturation Period (days), *: Difference between means is not significant, small letters show different groups at the 1 %

Table 2. Effect of GA3 doses (ppm) on yield parameters of potato clones

	3/110					6/28				
	0 ppm	5 ppm	10 ppm	15 ppm	Ort.	0 ppm	5 ppm	10 ppm	15 ppm	Ort.
ET	35bc	38ab	34bcd	30de	34B	16f	15f	27e	18.5f	19.0D
PH	83.11cde	43.11g	41.11g	57.22fg	56.14C	74.78def	65.44ef	65.44ef	77.00de	70.67B
MSC	1.11cd	1.00d	1.00d	1.30abcd	1.10B	2.00a	1.90ab	1.40abcd	1.80abc	1.80A
TC	6.10ghı	2.70j	4.30ıj	5.00hıj	4.5C	11.00bcd	6.30fghı	9.20cde	11.40abc	9.50AB
ATW	54.16bc	9.49g	21.37fg	40.53cde	31.39C	51.56bc	74.47a	54.83bc	52.09bc	58.24A
TY	328.3fg	25.5j	92.1j	201.2ı	161.8D	542.8bc	471.0cde	489.6cd	590.1ab	523.4A
MP	114d	114d	114d	114d	114D	121c	121c	121c	121c	121C
TSD	3/110					6/28				
	0	500	1250	2000	Ort.	0	500	1250	2000	Ort.
>45< mm	39.27 b-f	1.00g	4.18g	21.73defg	16.56D	48.13abc	44.44abc	50.20abc	58.72ab	50.73A
28-45 mm	33.79ab	3.70e	9.44de	23.35abcd	17.57A	11.50de	23.61abcd	19.37bcde	23.13abcd	19.40A
<28mm >	26.93de	95.30a	86.39a	54.93b	65.89A	40.37bcd	31.94cde	30.44cde	18.16e	30.23C

	7/12					10/15				
	0 ppm	5 ppm	10 ppm	15 ppm	Ort.	0 ppm	5 ppm	10 ppm	15 ppm	Ort.
ET	41.0a	42.0a	37.0ab	42.0a	40.5A	19f	31Cde	31cde	29de	27.5C
PH	66.00ef	99.00bc	106.20b	88.45bcd	89.92A	143.40a	67.00ef	91.22bcd	88.44bcd	97.53A
MSC	1.20bcd	1.70abcd	1.00d	1.20bcd	1.30B	1.20bcd	1.10cd	1.00d	1.44abcd	1.2B
TC	6.80fgh	8.70def	13.00a	7.20efgh	8.90B	12.00ab	9.20cde	8.20defg	12.60ab	10.50A
ATW	42.63bcde	52.95bc	49.05bcd	57.32b	50.49B	38.60cde	20.00fg	25.56ef	35.24def	30.60C
TY	287.9gh	423.1de	634.0a	405.4ef	437.6B	448.9de	183.7ı	230.2hı	436.7de	324.9C
MP	128.0 b	128.0 b	128.0 b	128.0 b	128.0 B	135a	135a	135a	135a	135A
TSD	7/12					10/15				
	0	500	1250	2000	Ort.	0	500	1250	2000	Ort.
>45< mm	19.74efg	55.85ab	42.61abcd	60.23a	40.61 B	39.82a-e	18.63fg	32.04cdef	29.33cdef	29.96C
28-45 mm	36.07a	16.63cde	20.92abcd	13.01cde	21.66A	27.99abc	24.05abcd	17.85bcde	19.89a-e	22.44A
<28mm >	47.61bcd	27.52de	36.48bcde	26.75de	34.59C	32.19cde	57.32b	50.11bc	50.28bc	47.47B

ET: Emergence Time (days); PH: Plant Height (cm); MSC: Main Stem Count (pieces); TC: Tuber Count (pieces); ATW: Average Tuber Weight (g); TY: Tuber Yield (g pot^{-1}); MP: Maturation Period (days); TSD: Tuber Size Distribution

Table 3. Effect of mycorrhizal doses (mg/100 tubers) on the yield parameters of clones

	3/110					6/28				
	0	500	1250	2000	Ort.	0	500	1250	2000	Ort.
ET	29.89cd	27.78d	25.67de	27.00d	27.58B	16.00f	15.00f	15.00f	19.00ef	16.25C
PH	83.11def	76.44defg	89.56cdef	83.78def	83.22B	47.78Efg	73.22fg	79.78defg	75.11defg	75.72B
MSC	1.11cd	1.00d	1.00d	1.30abcd	1.10B	2.00a	1.90ab	1.30abc	1.20bc	1.60A
TC	6.10ghı	7.40fgh	6.50gh	7.10gh	6.80C	10.60cde	10.20def	7.40fgh	9.10efg	9.30B
ATW	54.16bc	30.55fgh	46.51cde	33.00fgh	41.05B	51.56bcd	41.30c-g	60.55ab	40.45defg	48.50A
TY	328.3fg	220.10g	298.30efg	233.80fg	270.10B	542.80a	417.60bcd	436.00bc	396.60cde	441.5A
MP	114.0d	107.0e	107.0e	107.0e	108.8D	114.0d	114.0d	114.0d	114.0d	114.0C
TSD	3/110					6/28				
	0	500	1250	2000	Ort.	0	500	1250	2000	Ort.
>45< mm	39.27bcde	26.28cde	41.55a-e	39.11bcde	36.55AB	48.13abc	37.85bcde	62.67a	42.37abcd	47.75A
28-45 mm	33.80a	27.12ab	24.28ab	27.71ab	28.23A	11.50bc	17.24ab	17.54ab	27.29ab	18.39A
<28mm >	26.93b	46.60ab	34.17ab	33.18ab	35.27A	40.37ab	44.91ab	19.79b	30.34ab	33.85A

	7/12					10/15				
	0	500	1250	2000	Ort.	0	500	1250	2000	Ort.
ET	41.00ab	48.00a	39.44b	36.33bc	40.5A	19.33ef	28.55d	28.55d	28.55d	26.25B
PH	66.00g	101.60c	91.89cd	91.33cde	87.69B	143.40ab	145.20ab	130.20b	152.30a	142.80A
MSC	1.20bc	1.00c	1.10c	1.20bc	1.10B	1.20bc	1.30abc	1.20bc	1.20bc	1.20AB
TC	6.80gh	12.10bcd	6.50gh	6.90gh	8.10BC	12.00bcde	14.70ab	13.40bc	17.30a	14.40A
ATW	42.63cdef	36.82efgh	72.36a	54.11bc	51.48A	41.93cdef	27.51h	31.02fgh	28.35gh	32.50C
TY	287.90efg	436.00bc	468.30abc	375.10cde	391.80A	448.90abc	402.70bcd	410.50bcd	485.30ab	436.90A
MP	128.0b	121.0c	121.0c	121.0c	122.8B	135.0a	128.0b	128.0b	128.0b	129.8A
TSD	7/12					10/15				
	0	500	1250	2000	Ort.	0	500	1250	2000	Ort.
>45< mm	19.74e	30.03bcde	42.67abcd	49.63ab	35.52AB	39.82bcde	31.10bcde	22.87de	25.30de	29.82AB
28-45 mm	32.65a	32.14a	16.07ab	24.63ab	26.37A	27.99ab	28.61ab	18.83ab	28.65ab	26.02A
<28mm >	47.61ab	37.83ab	41.26ab	25.74b	38.11A	32.19ab	40.09ab	58.30a	46.05ab	44.16A

ET: Emergence Time (days); PH: Plant Height (cm); MSC: Main Stem Count (pieces); TC: Tuber Count (pieces); ATW: Average Tuber Weight (g); TY: Tuber Yield (g pot^{-1}); MP: Maturation Period (days); TSD: Tuber Size Distribution

Plant Height (cm)

Statistically significant differences at the 1% level were found in the plant heights of potato clones under both GA_3 and mycorrhiza applications. The reason for the higher plant height in the control group is thought to be due to the earlier emergence of plants in the control group (Table 1). In mycorrhiza applications, plant height ranged from 91.38 to 100.60 cm. The highest plant height was obtained from the application of 2000 mg/100 tubers of mycorrhiza, while the lowest plant height was observed in the control group. Mycorrhiza applications at doses of 500 and 1250 mg/100 tubers were statistically in the same group. Statistically significant differences were observed in the average plant heights of clones treated with GA_3. Plant height ranged from 56.14 to 97.53 cm. The highest plant height was recorded in clone 10/15 at 97.53 cm, followed by clones 7/12, 6/28, and 3/110. Clone 7/12 and clone 10/15 were statistically in the same group (Table 2). In mycorrhiza-treated clones, plant height ranged from 75.72 to 142.80 cm. The highest plant height was observed in clone 10/15, with other clones statistically in the same group. Plant height in the control group varied, with clone 3/110 at 83.11 cm, clone 6/28 at 74.78 cm, clone 7/12 at 66.0 cm, and clone 10/15 at 143.40 cm. In a study conducted by Atasever (2019) under field conditions, plant heights were determined as 76.8 cm in clone number 3/110, 79.6 cm in clone number 6/28, 78.1 cm in clone number 7/12 and 121.6 cm in clone number 10/15.

Main Stem Number (pieces plant^{-1})

The applied doses of GA_3 and mycorrhiza did not create statistically significant differences in the main stem number per plant. The main stem number ranged from 1.10 to 1.40 stems per plant with GA_3 application and from 1.2 to 1.4 stems per plant with mycorrhiza application. The reason for the lack of significant change in the main stem count due to GA_3 and mycorrhiza applications is that main stems emerge from the eyes on the seed tuber and GA_3 and mycorrhiza applications do not affect eye formation. The main stem counts of clones treated with GA_3 are presented in Table 2. The average stem count of clones was statistically significant, with the highest stem count of 1.80 stems obtained from clone 6/28, while other clones were statistically in the same group. Similarly, statistically significant differences were found in the main stem counts of clones treated with mycorrhiza, with the highest stem count obtained from clone 6/28. Other clones were statistically in the same group (Table 3). When examining the main stem counts of plants in the control group, counts ranged from 1.11 to 2.0 stems per plant. Clone 6/28 had the highest main stem counts among the control group. In the study by Atasever (2019), the number of main stems of clones numbered 3/110, 6/28, 7/12 and 10/15 was determined as 1.8, 2.0, 1.3 and 2.0, respectively.

Tuber Number (pieces plant^{-1})

The effect of different doses of GA_3 and mycorrhiza on tuber count was found to be statistically significant at the 1% level. The tuber count ranged from 6.7 to 9.1 tubers in GA_3 applications. The highest tuber count was obtained from the application of 15 ppm GA3, while the lowest count was from the 5 ppm GA_3 dose. In mycorrhiza applications, the highest tuber count was obtained from the 500 mg/100 tuber dose. The tuber count per plant ranged from 8.40 to 11.10 in mycorrhiza applications. This positive change is thought to be due to the better development of roots and below-ground parts with mycorrhiza application. Statistically significant differences were found in tuber counts among clones in GA_3 applications. The highest tuber count was obtained from clone 10/15 with 10.50 tubers per pot, followed by clones 6/28, 7/12, and 3/110. The average tuber counts of clones treated with mycorrhiza are presented in Table 3. Differences in tuber counts were statistically significant, showing similarities with tuber counts in GA_3 applications. From the control group, the highest tuber count per pot was obtained from clone 10/15, followed by clones 6/28, 7/12, and 3/110. In a study conducted by Öztürk (2022), tuber counts ranged from 5.8 to 10.3 tubers.

Average Tuber Weight (g)

The effect of different doses of GA_3 and mycorrhiza on average tuber weight is presented in Table 1. The impact of GA_3 and mycorrhiza applications on average tuber weight was found to be statistically significant at the 1% level. In GA_3 applications, the average tuber weight varied between 38.45 and 46.74 g. The negative effect of GA_3 application on average tuber weight is interpreted as being due to better vegetative growth of plants, resulting in the formation of numerous tubers with insufficient enlargement. Similar results regarding average tuber weight have been reported in studies by Haverkort and Marinus (1995), Mattar and Abdul (1988), Struick et al. (1989), and Mikitzel (1993). In mycorrhiza applications, the average mini-tuber weight ranged from 34.04 to 52.61 g. The highest average tuber weight was obtained from the application of 1250 mg/100 tubers of mycorrhiza, indicating that mycorrhiza applications increase mini-tuber size. Among GA_3-treated clones, clone 6/28 exhibited the highest average tuber weight. Statistically significant differences were observed among clones in terms of average tuber weight (Table 2). In mycorrhiza-treated clones, clone 7/12 had the highest average tuber weight and was statistically in the same group as clone 6/28. When comparing average tuber weights of untreated clones, clone 3/110 had the highest weight, followed by clones 6/28, 7/12, and 10/15.

Tuber Yield (g pot^{-1})

The effect of different GA_3 and mycorrhiza doses on mini-tuber yield was found to be statistically significant at the 1% level. Tuber yield averages ranged from 275.8 to 408.4 g/pot in GA_3 doses. The highest mini-tuber yield was obtained from the application of 15 ppm GA_3, which was statistically in the same group as the control group. In other studies, Abdala et al. (2000) mentioned that an increase in the number and length of stolons in potatoes leads to an increase in tuber count but may hinder tuber enlargement. For mycorrhiza applications, the highest tuber yield was obtained from the 1250 mg/100 tubers dose, while the lowest yield was obtained from the 2000 mg/100 tubers dose. Statistically significant differences were observed among clones in terms of tuber yield. Clone 6/28 had the highest tuber yield in both treatments. Among control groups, clone 6/28 had a higher tuber yield compared to other clones.

Tuber Size Distribution (%)

Values obtained for tuber size distribution were found to be statistically significant at the 1% level in both GA_3 and mycorrhiza applications. In GA_3 applications, the highest values were obtained from the >45 mm tuber size category in the 15 ppm GA_3 application, the 28-45 mm category in the control group, and the <28 mm category in the 5 ppm GA3 application. Both the 5 ppm and 10 ppm GA_3 applications were statistically in the same group for all three tuber size distributions. In mycorrhiza applications, statistically significant differences were observed only in the >45 mm tuber size category. Among GA_3 applications, there was no statistically significant difference in tuber size distribution between clones in the 28-45 mm category, while clone 6/28 had the lowest number of tubers smaller than 28 mm and the highest number of tubers larger than 45 mm. When examining the effect of mycorrhiza applications on tuber size distribution, clone 6/28 exhibited similarities with GA3 applications (Table 2). In another study aimed at seed potato tuber production by Şanlı and Cirit (2020), pre-planting application of 0, 1.5, 3.0, and 4.5 ppm GA_3 to seed tubers resulted in a statistically significant increase in tubers between 25-35 mm, while doses other than 1.5 ppm GA_3 significantly reduced the number of tubers larger than 60 mm.

Maturation Period (days)

GA_3 applications have been found to extend the maturation period, but the applied doses did not show statistical differences. The maturation period in the control group was determined to be 122.8 days, while it was 124.5 days in the GA_3-treated plants. On the other hand, mycorrhiza applications have been observed to shorten the maturation period compared to the control group, but there was no statistical difference among the applied mycorrhiza doses. The maturation period in the control group was determined to be 122.8 days, whereas it was 117.5 days in mycorrhiza-treated plants. When examining clones in terms of maturation period, according to Tables 2 and 3, it was determined that the clone with the earliest maturation period in both applications was 3/110, followed by clones 6/28, 7/12, and 10/15, respectively. Significant differences were found statistically among clone maturation periods in both applications. In the study conducted by Atasever (2019), the maturation period of the clones were determined as 119 days for clone number 3/110, 123 days for clone number 6/28, 119 days for clone number 7/12, and 113 days for clone number 10/15.

Conclusion and Recommendation

According to the results obtained, GA_3 and mycorrhiza applications did not have a positive effect on emergence time, did not cause a statistical change in the number of main stems in plants, while GA_3 application had a shortening effect on plant height, and mycorrhiza applications had an increasing effect. When the yield parameters were examined, it was determined that GA_3 application decreased the number, average weight, and yield of mini tubers per plant. However, mycorrhiza application increased the number of mini tubers but did not have a positive effect on the average weight and yield of mini tubers. For mini tuber propagation, mycorrhiza application at a dose of 500 mg/100 tubers is recommended.

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