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Propagation of Kiwi fruit with green cuttings under greenhouse conditions.

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Abstract

In our country Kiwi was imported from France during the 1970s, a period that coincides with its cultivation in the Republic of Macedonia and in other regional countries especially in the ex-republics of Yugoslavia. The first saplings were placed in a national nursery in Lushnja and according to the researchers of that period this plant adapted well to the conditions, providinghigh experimental yields. In the Albanian market, the Kiwi fruit was introduced after 1991, with imported products from Greece and Italy. While in 1994 the first kiwi seedlings imported from Montenegro were planted in Balldre-Lezhe area. To scientifically conduct the production of Kiwi seedlings from vegetative rootstocks, specialists from the University of Agriculture and farmers in Lezha District conducted different rooting tests in greenhouses with controlled temperatures and an automated irrigation system.The plantings were conducted at the beginning of every month starting from May till October. The experiment was conceived in 7 variants and 3 repetitions, while planting 150 vegetative rootstock\variant or approximately 1200 vegetative rootstocks in total. The testing variant was planted without any kind of stimulation. At the end of the experiment it resulted that the best rooting was achieved from planting the vegetative rootstocks during the months of June and July, while the worst rooting occurred from planting the rootstocks during the months of May and September. The optimal percentage of IBA Crystalline is 2500 and 3000 ppm and IBA talc is 2000 ppm.

Keywords: vegetative rootstocks, variant, repetition, spry irrigation system, phytohormones, IBA talc, IBA crystalline.

1. Introduction

In the history of development of agriculture, there are few subtropical plants which, during a short period of time have undergone such an immediate development as the kiwi plant. From a plant almost unknown during 1970-1980, in just a few years this plant disseminated at fast pace in countries with a Mediterranean or Oceanic climate. [1,11]. In Albania the kiwi plant originates at the same period as in the other regional countries. The first saplings were brought from France and were placed in a national nursery in Lushnja. According to the researcher N.Vërzhezha, the kiwi fruit adapted well enough and provided high experimental yields. [5,10]

The kiwi fruit in the Albanian market started to spread after the year 1990, mostly with imported products from Greece and Italy. The first areas were planted in 1995 in Baldre –Lezha area. After the 2000, other areas were supported with projects from the World Bank in Velipoje-Shkodër, Divjakë-Lushnjë, Elbasan, Llakatund-Vlorë, Seman-Fier, ect.

Today in Albania are planted under kiwi trees some 25 ha of land, especially along the Velipojë-Vlora coastal area. But this areas are very small when compared with the climatic and terrain potential that our country possesses. Despite these facts serious efforts are necessary for the set-up of basic theoretical and practical knowledge, to meet the need for saplings, for producing investments, in setting up new equipments, in unification of agro-technology production techniques, and for the creation, support and promotion fromofficial institutions of the production-accumulation-sell chain etc.

To contribute to the fulfillment of the tasks concerning production of fruit saplings from local farmers, the specialists at the Tirana Agricultural University in collaboration with two farmers in the agricultural region of Lezhë, conducted the experiment called: “ The production of kiwi saplings from half matured green cuttings ”.For this purpose were used atomizing (mist) irrigation equipments and the temperature was under constant control in the rooting banks. [8]

For planting were used half matured green cuttings from a spring-summer annual growth which were cut with three joints and were 10-12 cm long.The leafs of the base joints were removed while

the rest of the leafs are preserved. The air humidity must be maintained in levels between 80-85% so that the leaf mass is constantly wet and has peaty in more than 2\3 of its surface. [4,14]

As a rooting substrate was used a mixture of perlite-peaty in a rate of 60:40%. Before the cuttings were placed for rooting they are treated with the phytohormone IBA crystalline in six different concentrations and IBA talc 2000 ppm. One variant was reserved as a control test and was not treated in any way. [9]

After 40-50 days, the cuttings were transferred in 200 cc vases, at the moment when the main scion is 2-4 cm long. After 3-5 months of acclimatization and strengthening the scion, the saplings are ready to be planted in their permanent place.

The experiment defined the possibility of fulfilling this obligation by local producers that are within the national official standard. The results achieved from the application of this method of multiplication are satisfactory and compared with the wood cuttings in levels of 50-55%.

2. Material and methods

The study of the opportunity of production of the kiwi saplings from green vegetative cuttings was achieved based on a experimental method that was put together by specialists from Agricultural University of Tirana. The tests of rooting were conducted with atomizing (mist) irrigation, within controlled levels of temperature and humidity. For the rooting were used green cuttingstaken from spring-summer annual grown plants, while the plantings were conducted at the start of every month from 05 May-05 September, excluding August as the most difficult month to manage the required parameters in terms of temperature andhumidity in the greenhouse.

The environment inside the greenhouse is controlled in terms of the temperature, humidity and aeration, while the substrate is perlite with wide 20 cm. The temperature of the rooting is conserved between 22-26 °C and the humidity at 85-90%.

The experimental test was repeated for two consecutive years, respecting the time of planting, the measures of the saplings, the concentration of the stimulants, the mixture of the substrate, the temperature and the humidity in the banks etc. The 'Mother' plants are 15 year old and well treated technically or agronomically.

The study was conceived in 8 variants x 3 repetitions, planting for every variant\repetition approximately 150 cuttings or a total of 1200 pieces. In the four terms of the experiment were planted 4800 cuttings. As a control test was applied the planting without treating the plant with phytohormones or variant V0.

For the rooting were used pieces of the cultivar Hayward **[13]**, while as a stimulant IBA crystalline in six different concentrations and a variant with IBA powder 2000 ppm. In all the variants and test terms, the cuttings were left with two full leafs, the base cut was made very near the last joint, while the phytohormone was used for 5-7 seconds. In the case of IBA talc, before the treatment, the cuttings were cleaned with fresh water and only after that were treated with stimulants.

Table 1. The experimental programme and its terms of fulfillment.

No.	*Varints*	*Repetitions*	*Cuttings for rooting*	*Stimulants*	*Test terms*				*Cutings in total*
					05\05	05\06	05\07	05\09	
1.	V0	3	50 x 3	Without treatement	150	150	150	150	600
2.	V1	3	50 x 3	IBA 1000 ppm	150	150	150	150	600
3.	V2	3	50 x 3	IBA 2000 ppm	150	150	150	150	600
4.	V3	3	50 x 3	IBA 2500 ppm	150	150	150	150	600
5.	V4	3	50 x 3	IBA 3000 ppm	150	150	150	150	600
6.	V5	3	50 x 3	IBA 4000 ppm	150	150	150	150	600
7.	V6	3	50 x 3	IBA 5000 ppm	150	150	150	150	600
8.	V7	3	50 x 3	IBA talcë 2000 ppm	150	150	150	150	600
	Total	**3**	**8 x 50 x 3**	**-**	**1200**	**1200**	**1200**	**1200**	**4800**

3. Results and discussion

The main analysis is to estimate the rooting percentage of the planted saplings in different terms, this is also the main purpose of this experiment. The verification was done through the physical counting of 1200 cuttings of each test, while the results of each month and the two year average were registered in the corresponding electronic tables.

The mean values of rooting of the green kiwi cuttings from May to September

From the two year data analysis, for the rooting results of the green cuttings during the period from May to September is demonstrated that the average rooting is 22.5%. Good results are achieved through the variants V7, 53,2%by treating the cuttings with IBA talc 2000ppm, V4 48% by treating the cuttings with crystalline IBA 3000 ppm and V3, 29.5% by treating the cuttings with IBA crystalline 2500 ppm.

The difference is also verified statistically with the creation of three different homogenous groups from V1. Statistically there are no differences between V1, V2, V5 and V6, while there are differences between V4, V7 and V3. Variants V4 and V7 are found in the same homogenous group regardless the differences in the arithmetical percentage. As economically convenient variants are considered those with the best rooting percentage, in practice as economically convenientmust be consider variants V7 and V4.

Table 2. The average values ofrooting for the kiwi green cutings from May to September.

No.	***Variants***	***Monitored Indicators during the period May-September.\mean***			
		Total of planted cuttings	Total of rooted cuttings	Rooting %	Homogenous groups
1.	V0	600	3	0	a
2.	V1	600	54	9	b
3.	V2	600	96	16	b
4.	V3	600	177	29.5	c
5.	V4	600	288	48	d
6.	V5	600	127	21.2	b
7.	V6	600	18	3	b
8.	V7	600	319	53.2	d
-	**Total**	**4800**	**1082**	**22.5**	0
	DMV = 8.68,				

From the evaluation of the rooting results for every planting term 05 May, 05 June, 05 July, 05 August and 05 September is proved that the rooting indicators of the cuttings usually keep the same course, with a few more percentage points for the plantings in the months of June and September when the used cuttings are only 1\2 matured. Even in this cases the best results are achieved through variants V7, V4, V3.

For the 05 May term, the rooting test demonstrates that the best variants are V4; 46% and V3, 30% where the cuttings are treated with IBA crystalline 3000 and 2500 ppm and V7; 51.3% were is applied a treatment with IBA talc 2000 ppm. The results coincide with the literature and the tests conducted by IK Biology in Tirana and other researchers in countries where the kiwi plant is cultivated.

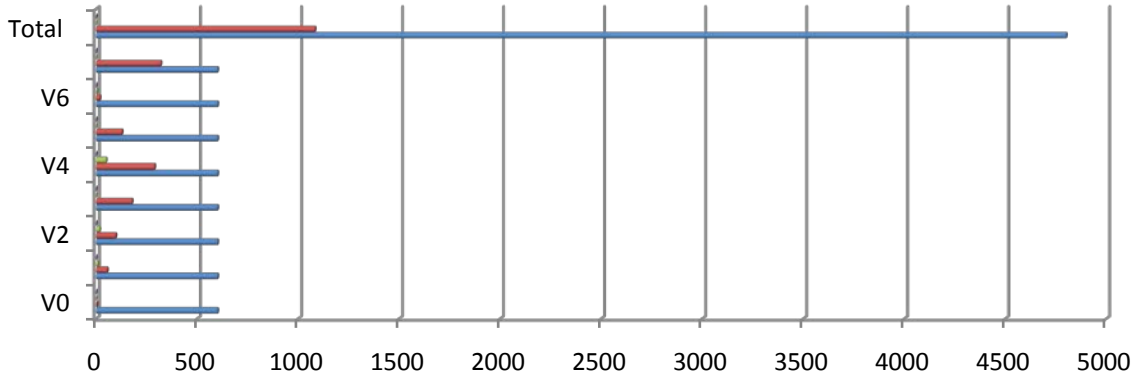

Figure 1. The mean values ofrooting of the kiwi green cutings from May to September

In terms of rooting percentage for 05 June our indicators are positive. In this case it is judged that the positive impact comes from the maturation of the cuttings. The best variants are V4; 50%where it is applied IBA crystalline 3000 ppm, V7; 58%where it is applied IBA talc 2000 ppm and V3;32%, where it is applied IBA crystalline 250ppm.The results are confirmed evens statistically with the creation of four homogenous groups different from V1.

For the month of July the results follow the same course, but the rooting percentages are smaller if compared with the two previous months. This is related with the period of the planting of the saplings, till the moment of the creation of a *callus*. The plants go through stress because of very high temperatures, there are difficulties to manage and conserve the greenness and the leaf's *turgor*. The best results for this term are achieved through V4; 44% and V3; 22.6% where it is applied IBA crystalline 3000 and 2500 ppm and V7; 48.6% where it is applied IBA talc 2000 ppm. The difference is statistically proven through the creation of three homogenous groups different from V1.

For the month of September, the percentage of the rooting result is considered good, while positive indices are achieved through V5, 52%; V4, 48.6% ; V3, 21.3% / IBA crystalline 4000, 3000 and 2500 ppm/ and V7, 42.6%/ IBA talc 2000ppm. The cuttings used for rooting during the month of September are more matured compared with the previous months, while is concluded that during the two years of testing IBA crystalline in a 4000 ppm concentration brings the highest results of rooting during the months of May, June and July. The results coincide with the conclusions achieved from other kiwi researchers in Albania, but also in other countries where kiwi is cultivated.[2,3,5].

The evaluation of the length of the scion according to the planting period and the IBA stimulant dose

According to this evaluation test,in total there prevail the produced saplings with a scion 20 cm long composed of 78.1%, while those long 21-40 cm composed of 21.9%. On an average level, as the best variants are V7, V4 and V3, where the scions 21-40 cm long occupy respectively 27.1; 25.4 and 21.5%.The difference is also proved statistically with the creation of two homogenous groups different from V1.

Table 3. Mean values of the length of the kiwi scion May-September

No	***Variants***	*Shooted saplings*	***Length of the scion in, May - September***				***Homogenous Groups***
			Till 20 cm	%	21 – 40 cm	%	
1	V0	3	3	100	-	-	a
2.	V1	54	48	88.8	6	11.2	b
3.	V2	96	82	85.4	14	14.6	b
4.	V3	177	139	78.5	38	21.5	b
5.	V4	288	210	72.9	78	27.1	c
6.	V5	127	107	84.2	20	15.8	b
7.	V6	18	18	100	-	-	a
8.	V7	319	238	74.6	81	25.4	c
-	**Total**	**1082**	**845**	**78.1**	**237**	**21.9**	**DMW = 10.25**

The statistical analysis proves that between V1, V2, V3 and V5 there is no statistical difference. While in V4 and V7 the difference is proved through the creation of a new statistical group, between V4 and V7, there are no statistical differences despite the differences in mathematical percentages that exist between them.

Analyzing the index "scion length" for the term 05 Mayas the best variants result V3, V4 and V7 that are achieved through a treatment with IBA crystalline 3000, 2500 ppm and IBA talc 2000 ppm. In total the saplings circa 20 cm long prevail with a percentage of 77.4%, while the saplings 21-40 cm long represent only22.6%.The results are dominated by V7; 28.6%, V4; 26.51% and V3; 23.6%. The differences are proved statistically through the creation of three homogenous groups different from V1.

For the term 05 June the scion situation is higher compared with May. The saplings circa 20 cm long represent 74.8%, while we have a bigger percentage with saplings 21-40 cm long, with a total of5.2% the best variants are V4; 30.7%, V7; 26.4% and V3; 25%. The difference is proved statistically through the creation of three homogenous groups different from V1. Between V3 and V6 there are no statistical differences, this situation is verified even between V1, V2 and V5

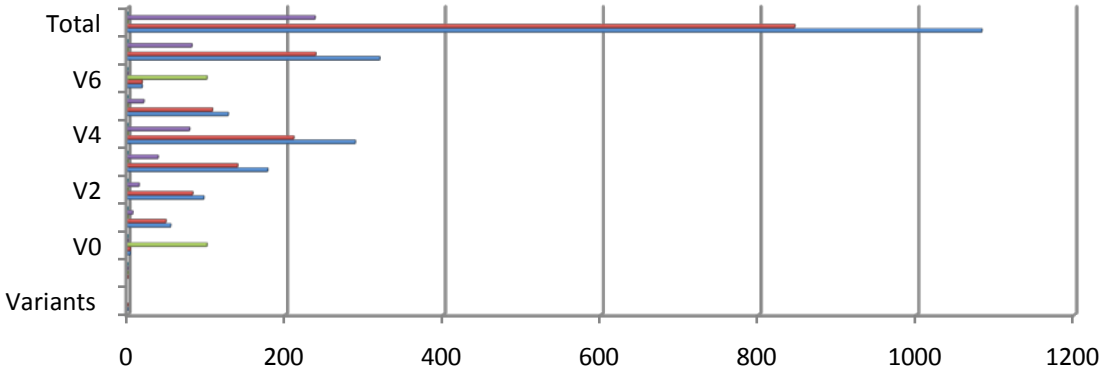

Figure 2. Average length of the Kiwi scion from May to September.

For the term 05 July the same course is preserved, but the results are lower if compared with the results of May and June. The saplings with a scion circa 20 cm long the figure is at 84%, while those with a scion 21-40 cm longthere is only 16%. The best variants are V4; 22.7%, and V7; 20.6%. The difference is even proven statistically through the creation of two homogenous groups different from V1.

Figure 3.(1,2). The new growth[1] of the kiwi scions and the rootingbanks[2]

During the term of September the rooting results in percentage are considered good, the cuttings are half matured, while the best indices are obtained through V5; 52%, V4; 48.6%, V3; 21.3% / IBA crystalline 4000, 3000, 2500 ppm and V7; 42.6% / IBA talc 2000 ppm. For this term it is proved that the rooting process is influenced by the increased concentration of the stimulant. The cuttings planted in this month are more matured compared to the previous months. Consequently the treatment with IBA talc has achieved weaker results compared with IBA crystalline, and it is also proved that the concentration 4000 ppm obtains a bigger percentage of rooting compared with the plantings in the months of May, June and July.

The difference is proved statistically through the creation of four homogenous groups different from V1, V4 crates an independent group, while V7 and V3 do not have statistically proved differences.For this term we have a display of rooting even in the untreated variant (V0) but in small numbers and with a very weak rooting system.[15].

The evaluation of the root system according to the terms of planting and the dose of IBA stimulant.

According to this evaluation test, the classification of the root system is done in two levels, where we basically verify and measure the length of first and second skeletal roots, but also the mass of the covering roots.

From the evaluation of the mean indices of the main root's length we note that, in the total number of the saplings dominate those with a root 10 cm long in a mass of 79.9%. The saplings with a more developed root system or over 11-20 cm long, are achieved through the variants V4; 26.1%, V7; 25.4% and V3;14.7%.

According to the data from the table above, for this index the best results are achieved with the plantings in the months of June and September.

Table 4. The evaluation of the root system in acordance with the averageplanting terms fromMayto September

No.	*Variants in the experiment*	*Mean length of the root system May- September*				
		Rooted cuttings \ total	Till 10 cm	%	11 – 20 cm	%
1.	V0	3	3	100	-	-a
2.	V1	54	54	100	-	-b
3.	V2	96	86	80.2	10	10.4 b
4.	V3	177	151	85.3	26	14.7 b
5.	V4	288	213	73.9	75	26.1 c
6.	V5	127	111	87.4	16	12.6 b
7.	V6	18	18	100	-	-
8.	V7	319	238	74.6	81	25.4 c
-	**Total**	**1082**	**874**	**80.7**	**208**	**19.3**
		DMV = 5.46				

During the term starting as of 05 May there prevail saplings with the main root 10 cmlong in the mass of 81.6%. The saplings 11-20 cm long are at 18.4%,while variants V4 and V7are better presented, where the root mass 11-20 cm long stands at 24.6 and 20.8% respectively. A vigorous root influences a vigorous scion and as a consequence its heredity.

During the term as of 05 June, the results of the rooting pieces are good, while the skeletal roots 10 cm long prevails with 80%. Even in this month, the best variants are V4;26.7% of the saplings with skeletal roots11-20 cm long and V7; 23% of the saplings with skeletal roots 11-20 cm and V3; 20.9%.

Figure 4.(1,2). Green cuttingswithdifferentplanting times.[1,2]

In the case of July it is proven that 87.5% of the skeletal roots of the green cuttings are 10 cm long, while only 12.5% of the cuttings have skeletal roots longer than 11-20cm.At their best are presented the variants V4 with 21.2% and V7; 17.8%. The results of July, are lower than those of May, June and September. In this planting term the delay in the planting of the cuttings has an impact, as has the high temperatures and the shortest physical time that they go through till the losing of the leaves. At the same time it is established that the variants V1, V5 and V6do not have saplings with skeletal roots 11-20 cm long.

Duringthe term starting as of 05 September we observe that the quantity of saplings with a root till 10 cm long represents 83.3%, while those with a 11-20 cm long represent 16.7%. Despite the delayed period of planting compared with the other months, the produced saplings are very competitive.The best variants for the rooting indices with 11-20 cm long are verified in V4; 20.5% and V7; 18.3%. **[**7,12].

The results of the statistical analysis verify the existence of a difference between variants (rows). This situation is related with the impact of the hormone's concentration on the percentage of rooting. A difference is also proved between repetitions (columns), a situation that originates from the time of saplings. This conclusion is verified through the values of both indices of statistical (F) and (P-value), both indices are calculated through a two factorial analysis (Anova Test).

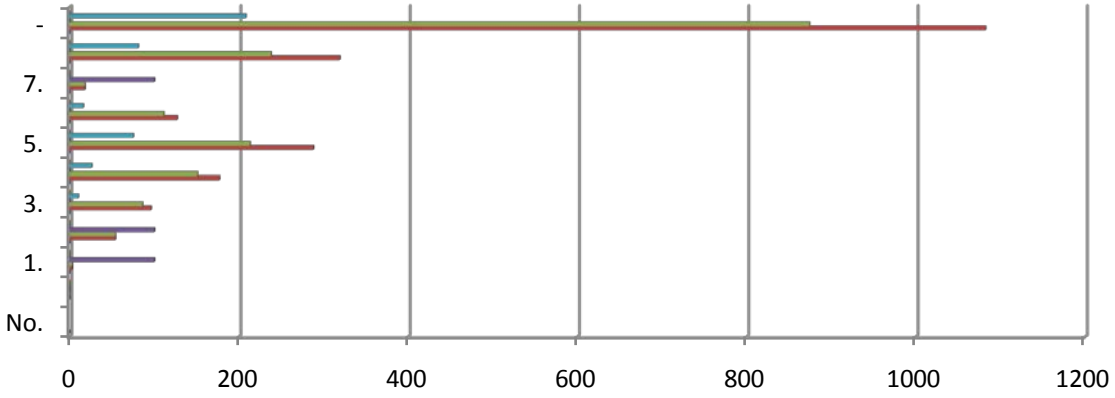

Figure 5. The evaluation of the root system in accordance withaverageplantingterms, from May to September

The difference obtained from the IBA concentrations F=13.94825 is bigger than the tabular value F-crit=2.487578. The same situation is obtained also for the results of the repetitions. This proves the difference because of the time of sampling, 16,83008>3.072246.

The probability value P-Value, in both cases is smaller than the value of the security level (a=0.05). Concretely P-value (1.29 E-06 and 8.39 E-06) Ëa=0.05. This means that there are two factors that influence the rooting percentage: the concentration of the IBA hormone (the difference comes from the repetitions) and the sampling period. From the statistical analysis results are created for two homogenous groups different from V1.**[15].**

4. Conclusions

The two-year analysis of the experimental results of the production of Kiwi saplings from half matured green cuttings in atomizing (mist) greenhouses in controlled humidity and temperature conditions proves that:

The best results are achieved from planting the saplings during the months of May, June and September, although with some reserves we can plant it even in the month of July

The best concentration of IBA Crystalline phytohormone is evaluated 2500-3000 ppm and IBA talc 2000 ppm

The optimal length of the green cuttings is 10-12 cm, with three junctions and two full leafs

Evaluated from the rooting percentage, the scion's length and the root mass, as the best variants should be considered V7, V4 and V3.

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