

INFLUENCE OF LEAF AREA ON THE ROOTING PERCENTAGE OF KIWIFRUIT CUTTINGS, PRE-TREATED WITH IBA 3000 PPM

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Abstract

Kiwifruit (*Actinidia deliciosa* C. F. Liang & A. R. Ferguson) is very interesting and a very important fruit tree in the world's horticultural history. While the area under cultivation and kiwifruit production in the world is increasing year by year (over 2 million tons), a big issue is the seedling production. Kiwifruit can be propagated with seeds, vegetative cuttings, and micropropagation.

The paper presents the influence of leaf area on rooting of greenwood and semi-hardwood cuttings of kiwifruit. The study was conducted during two consecutive years, 2012-2013, in a private greenhouse in Lezha, using two periods of taking cuttings: July 5, with greenwood cuttings, and September 5, with semi-hardwood cuttings. A randomized complete block design (RCBD) with two variants (full leaf cuttings and half leaf cuttings) and three replications, with a plot size of 100 vegetative cuttings for variant for each replication, was used. Vegetative cuttings were pre-treated with indol-3-butyric acid (IBA) 3000 ppm and were planted on a perlite-peat mix (60:40) supporter, under controlled environmental conditions (air temperature 22-26°C, basal perlite-peat mix temperature 17-18°C, and 90-95% RH). In July, the experimental greenhouse was shaded with a black mesh. Obtained results showed that greenwood and semi-hardwood cuttings with ½ of leaf area rooted better than cuttings with full leaf area, in both planting periods (55.3% versus 51%, and 68% versus 64%). The highest rooting percentages were achieved using semi-hardwood cuttings planted in September 5 with ½ leaf area (68%) and full leaf area (64%). Differences between variants were testified using LSD and statistical ANOVA-tests.

Key words: greenwood cuttings, kiwifruit, leaf area, rooting percentage, semi-hardwood cuttings.

INTRODUCTION

Kiwifruit (*Actinidia deliciosa* C.F.Liang & A.R.Ferguson), often shortened to **kiwi** in many parts of the world, is the edible berry of a woody vine in the genus *Actinidia* (Stirk, 2005). Kiwifruit is native to southern China, where it is declared a National Fruit of China and can be grown as wild and half-cultivated plant, while other species of the genus *Actinidia* are native to India, Japan, and south-eastern Siberia (Ferguson, 1999). There are different thoughts about the number of kiwifruit species all over the world (Latocha, 1988). Some authors (Ferguson, 1999) report about 60-70 species, but others think that this number is higher. Hundred and fifty five species of *actinidia* have eaten kiwifruits (Debersaques and Mekers, 1987). Species which have fruits that are

commonly eaten are golden kiwifruit (*Actinidia chinensis*), Chinese egg gooseberry (*Actinidia coriacea*), baby kiwifruit (*Actinidia arguta*), Arctic kiwifruit (*Actinidia colomicta*), red kiwifruit (*Actinidia melanandra*), silver vine (*Actinidia polygama*), and purple kiwifruit (*Actinidia purpurea*) (Ferguson, 1999; Lee, 1990). Kiwifruit is a perennial (>40-45 years) dioecious vine, with separate male and female plants. Some of species are evergreen and, because of their beautiful creamy flowers, (especially male flowers), can be used as ornamental plants (Dedersaques and Mekers, 1987). Kiwifruit can be grown in most temperate climates with adequate summer heat. The most sprout species are *Actinidia deliciosa* (green kiwifruit or fuzzy kiwifruit), *Actinidia chinensis* (golden kiwifruit), and *Actinidia arguta* (baby kiwifruit). *Actinidia arguta* is sprout mainly in some countries, like Switzerland, Rumania, and Austria, where low temperatures are limited factor for *Actinidia deliciosa* and *Actinidia*. Almost all kiwifruit in commerce belong to a few cultivars of fuzzy kiwi (*Actinidia deliciosa*), such are “Hayward”, “Blake”, and “Saanichton 12” (Stirk, 2005). The most common male pollinators for this variety are “Chico” and “Mattua”. As a result of bud mutation of cultivar “Hayward”, in Italy, there are selected several clones, such are “Clone 8”, “Clone K”, “Clone Maeba”, “Top Star”, “Green light”, “Earlygreen”, etc, and several important varieties, such are “Summerkiwi”, “Summer 3373” dhe “Summer 4605”, which can be ripen 30-50 days prior to “Hayward” (Ferguson and Costa, 2011).

In Albania, kiwifruit is not wellknown and its domestic cultivation started in 1994, in Balldre Lezhë, using kiwifruit seedlings imported from Montenegro (Gjeloshi, 2007; Çeko *et al.*, 2002). In Montenegro, kiwifruit orchards occupy over 50-60 ha, planted with “Bruno”, “Monty”, “Abbott”, and “Hayward” cultivars (Peroviç *et.al*, 1987). After 2002, in Albania, started the commercial planting by some farmers in Divjaka, Velipoja, Llakatund, Fier, Tiranë, Elbasan, showing high fruit quantity and quality, under plain Mediterranean climate conditions (Gjeloshi, 2007). Some studies show that kiwifruit find appropriate cultivation conditions, especially in the western plain and hilly areas of Albania (Gjeloshi, 2007). Because of the kiwifruit’s importance, there is a need for seedling production and new kiwi orchard construction. Seedling production of kiwifruit can be using traditional methods and rooting of vegetative cuttings in greenhouses. Recently, a farmer in Lezha (Gj. Gjeloshi) has started seedlings production of kiwifruit, using mainly greenwood, semi-hard wood and hardwood cuttings, pre-treated with Indole-3-Butyric Acid (IBA) (Gjeloshi *et al.*, 2013). Any living vegetative plant tissue, cambium, epidermis, parenchyma of the bark, etc., can form roots if there are appropriate environmental conditions and if there is a certain level of phytohormon contents (growth regulators). The high hormone concentrations provoke the cambium and pericycle cell division from where the process of root formation starts. Roots originated from vegetative plant’s parts under the hormone effect are similar to roots naturally formed (Hartman & Kester, 1990). For vegetative cuttings rooting acceleration can be used growth regulators such are Indole-3-Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) (Rama, 2010) in appropriate concentration, because very high concentrations of the rooting hormones inhibit the rooting process (Rama, 2010). Susaj *et al.*, (2011) and Lekaj *et al.* (2011) have shown that the use different NAA concentration affected significantly the rooting percentage of the vegetative cuttings of thuya “Emeraud”, as well as the seedling quantity. Some early workers (Bhattacharya *et al.*, 1978), have reported that indol-3-butyric acid (IBA) and gibberelic acid (GA3) enhanced the formation of roots on the stem cuttings of *Abelmoschus esculentus* Moench.

MATERIALS AND METHODS

The study was conducted during two consecutive years, 2012-2013, in a private greenhouse in Lezha, using two periods of taking cuttings: July 5, with greenwood cuttings, and September 5, with semi-hardwood cuttings. Greenwood and semi-hard cuttings were taken from healthy mother plants of 10 years old, cultivar “Hayward”, from the middle part of the one year vines, with a length of 12 cm (3-4 buds) and a diameter of 8-10 mm. A randomized complete block design (RCBD) with two variants: V1 - full leaf cuttings, and V2 - half leaf cuttings, and three replications, with a plot size of 100 greenwood and/or semi-hardwood cuttings for variant for each replication, was used. Vegetative cuttings were pre-treated with indol-3-butyric acid (IBA) 3000 ppm and were planted on a perlite-peat mixture (60:40) supporter, under controlled environmental conditions. Prepared IBA solution 3000 ppm was poured into Petri dishes, and the bottoms of the vegetative cuttings were dipped for a few seconds (5-7 sec). After the treatment with IBA, the kiwifruit vegetative cuttings were placed for rooting in distances 10 cm x 5 cm, sowing 200 vegetative cuttings per m². The air temperature in greenhouse was kept of 22-26°C, basal perlite temperature 17-18°C, and air humidity 90-95%. In July, the experimental greenhouse was shaded with a black mesh.

Planting of the vegetative cuttings for rooting was carried out at the same period for the two consecutive years. Twenty days after sowing, there were observed the formation of root nodules and callus ring at the end of vegetative cuttings. Fifty days after sowing, was carried out the seedling traplantation, were counted rooted seedlings (rooted cuttings), was evaluated the rooting percentage, and was measured the root length for each variant on each replication. Vine length was measured 80 days after planting for each variant on each replication. Differences between variants, cuttings with full leaf and half leaf, and planting periods were testified using statistical tests [LSD (95%) and ANOVA test] (Papakroni, 2001).

RESULTS AND DISCUSSION

Effect of leaf area on rooting percentage of the greenwood and semi-hardwood kiwifruit cuttings, pre-treated with IBA 3000 ppm, planted in different periods.

Observed results showed that the leaf size (leaf area) significantly affected the rooting percentage of the greenwood and semi-hardwood cuttings of kiwifruit. The highest rooting percentage was achieved using half leaf hardwood cuttings planted in September 5 (68%), while the lowest rooting percentage was achieved using full leaf greenwood cuttings (51%). There were observed significant differences for variants (full leaf cuttings and half leaf cuttings) and for different vegetative cuttings (greenwood cuttings planted in July 5 and semi-hardwood cuttings planted in September 5) (Table 1).

Table 1. Mean values of the observed rooting percentage of the full leaf and half leaf greenwood and semi-hardwood cuttings (superscript small letters indicate significant differences between variants at the same sowing period and superscript caps letters indicate significant differences between sowing periods – different vegetative cuttings at $p < 0.05$).

Variants	Planted cuttings	July 5 (greenwood cuttings)		September 5 (semi-hardwood cuttings)	
		Rooted cuttings	%	Rooted cuttings	%
V1 (full leaf cuttings)	300	153 ^{bD}	51	192 ^{bB}	64
V2 (½ leaf cuttings)	300	166 ^{aC}	55.3	204 ^{bA}	68

Effect of leaf area on rooting system development (root length) (cm) of the full leaf and half leaf greenwood and semi-hardwood kiwifruit cuttings, pre-treated with IBA 3000 ppm, planted in different periods, at the traplantation period.

Measurements of the rooting system (root length) (cm) was carried out fifty days after sowing, consisting on the traplantation period, for both planting periods. Results showed that rooting percentage was not in the right proportion with root length of rooted cuttings or future seedlings. For greenwood cuttings planted on July 5, there were observed significant differences between variants (full leaf and half leaf cuttings) for root length up to 10 cm (128 versus 116 cuttings), but not for root length over 10 cm (38 versus 37 cuttings) (Table 2). For semi-hardwood cuttings planted on September 5, there were observed significant differences between variants (full leaf and half leaf cuttings) for root length up to 10 cm (117 versus 98 cuttings), and for root length over 10 cm as well (87 versus 94 cuttings) (Table 2). The highest quality seedlings were achieved using semi-hardwood cuttings with half leaf, planted on September 5.

Table 2. Mean values of root system development (root length) (cm) of the full leaf and half leaf greenwood and semi-hardwood cuttings at the traplantation period (different letters indicate significant differences between variants at the same sowing period at $p < 0.05$).

Variants	July 5 (GWC)			September 5 (SHWC)		
	Rooted cuttings	Root length		Rooted cuttings	Root length	
		Up to 10 cm	>10 cm		Up to 10 cm	>10 cm
V1 (full leaf cuttings)	153	116 ^b (75.8%)	37 ^a (24.2%)	192	98 ^b (51.04%)	94 ^a (48.96%)
V2 (½ leaf cuttings)	166	128 ^a (77.1%)	38 ^a (22.9%)	204	117 ^a (57.35%)	87 ^b (42.65%)

Effect of leaf area on vine growth (vine length) (cm) of the full leaf and half leaf greenwood and semi-hardwood kiwifruit cuttings, pre-treated with IBA 3000 ppm, planted in different periods, 80 days after planting.

Measurements of the vine growth (vine length) (cm) was carried out 30 days after traplantation (80 days after planting) for both planting periods. Observed results showed that cuttings leaf area significantly affected the rooting percentage, but not vine development (vine length) of the future seedlings. For greenwood cuttings planted on July 5, there were not observed significant differences between variants (full leaf and half leaf cuttings) for vine length up to 20 cm (65% versus 63%) and for vine length over 20 cm (35% versus 37%) (Table 3), while, for semi-hardwood cuttings planted on September 5, there were observed significant differences between variants (full leaf and half leaf cuttings) for vine length up to 20 cm (66% versus 58%) and for vine length over 20 cm (34% versus 42%) (Table 3).

Table 3. Mean values of vine growth (vine length) (cm) of the full leaf and half leaf greenwood and semi-hardwood cuttings, 30 days after traplantation (different letters indicate significant differences between variants at the same sowing period at $p < 0.05$).

Variants	July 5 (GWC)			September 5 (SHWC)		
	Rooted cuttings	Vine length (cm)		Rooted cuttings	Gjatësia e lastarëve (cm)	
		Up to 20 cm	>20 cm		Up to 20 cm	>20 cm
V1 (full leaf cuttings)	153	97 ^b (63%)	56 ^a (37%)	192	112 ^b (58%)	80 ^a (42%)

V2 (½ leaf cuttings)	166	108 ^a (65%)	58 ^a (35%)	204	136 ^a (66%)	68 ^b (34%)
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Obtained data were similar to Gjeloši *et al.* (2013) findings, who have reported that kiwifruit cuttings (seedlings) show a vigorous growth after rooting, although in the early stages show a slowly growth. For kiwifruit seedling producers, rooting percentage of the vegetative cuttings seems to be the most important issue on seedling production (Gjeloši *et al.*, 2013).

CONCLUSIONS

Greenwood and semi-hardwood cuttings leaf area significantly affected the rooting percentage, root system development and vine growth. Greenwood and semi-hardwood cuttings with half of the leaf rooted better than cuttings with full leaf area, in both planting periods (July and September). The highest rooting percentages were achieved using semi-hardwood cuttings with half of the leaf, planted in September 5, by 68%. Achieving of higher rooted cuttings is the most important issue for kiwifruit seedlings producers, since kiwifruit cuttings recover the slow growth in the early stages.

The best quality seedlings of kiwifruit, with a strong rooting system and normal vine growth, can be guaranteed using semi-hardwood cuttings with half of the leaf planted in September.

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