Influence of natural leaf drop and nutritional status of the stock plant on rooting of peach cuttings

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ABSTRACT: This study showed that rooting is strongly affected by natural leaf drop occurring during cutting collection. Observations carried out during sampling showed that cultivars with more than 80% leaf drop had lower rooting percentages than cuttings from cultivars with leaf drop between 44 to 75%, and that generally, the peaks of leaf drop coincide very closely with low rooting. Besides, it was found that there is a relation between Fe and N content in the bark of cuttings and their rooting. The peaks of Fe content coincide with the peaks of rooting. In contrast, the peaks of N content coincide with the lowest percentage of rooting. Overall, there seems to be no clear-cut relation between rooting and contents of P, K, Ca, Mg, Mn and Zn.

Keywords: elements; hardwood cuttings; peach; cultivars; rooting

There is enough evidence that the nutrition of the stock plant exerts a strong influence on the development of roots and shoots of cuttings taken from it (BARTOLINI et al. 1988; HARTMANN, KESTER 1975; MONCOUSIN, MASCHERPA 1991; WIEBEL et al. 1990). BLAZICH (1988) reported that nitrogen was mobilized during root initiation in stem cuttings of kidney bean (*Phaseolus vulgaris*) and plum (*Prunus* L. Mariana 2624). Mobilization of P but not of N, K, and Ca (GOOD, TUKEY 1967) was reported during root initiation in cuttings of chrysanthemum (*Chrysanthemum morifolium* Ramat cv. Indianapolis White). Plants grown at low or medium levels of nitrogen had better rooting than with the higher level of nitrogen (BATTIN 1990). Overall, nitrogen treatments had a greater influence on the rooting response of cuttings than P or K treatments although a positive response to P and K was observed in some treatment combinations (PRESTON et al. 1953). A high level of Mn was found in the leaf tissue of cuttings taken from difficult to root cuttings of avocado (*Persea americana* Mill.) (REUVERI, RAVIV 1981) while the opposite was found in cuttings of easy to root cultivars. Zinc fertilization of stock plants increased the percentage of rooted cuttings of grape (*Vitis* L. cv. Chasselas X Berlandieri 41B) (SAMISH, SPIEGEL 1958). Ca and Mg are sometimes mobilized from the stem base to support growth in the upper portion of the cutting (BLAZICH et al. 1983).

Leaf drop influences the hormone balance, nutrient content and carbohydrate composition of plants. Therefore, it is possible to influence the rooting of cuttings by leaf drop and phenological phases of mother plants.

The aim of this study was to investigate if there is any relation between leaf drop and mineral nutrient content of cuttings and their influence on the rooting.

MATERIAL AND METHODS

Shoot cuttings (20 cm in length) were taken from eight-year-old peach cultivars (Early Crest, May Crest, Flavor Crest, Sun Crest, Fayette, Katerina, Loadel, Andross, Everts, May Grand, Fire Bright, Fairlane) grafted on GF677 peach rootstock on 6th November 1998 and repeatedly on 15th November 1999.

The bases of the cuttings were immersed for 15 seconds to a depth 10mm of IBA at 2,000 mg/l, in a 50% ethanol solution. After drying, the base surfaces were treated with Captan 75 (1:9 in talc). The cuttings were then planted in sand on bottom-heat benches, the temperatures being regulated at 18–20ºC.

Table 1. Effect of peach cultivars and natural leaf drop during cutting collection on rooting percentage of peach hardwood cuttings

Cultivars	Rooting (%)		Leaf fall (%)	
Early Crest	5.40[a]	e	82.0	b
May Crest	16.30	c	62.0	fg
Flavor Crest	11.90	d	83.0	b
Sun Crest	3.30	e	88.0	a
Fayette	11.90	d	80.8	b
Katerina	17.40	c	44.2	h
Loadel	25.00	b	75.0	c
Andross	24.90	b	73.0	cd
Everts	14.10		65.8	ef
May Grand	32.80	a	59.4	g
Fire Bright	25.00	b	69.7	de
Fairlane	28.20	b	58.1	g

[a]The values in each column with the same letter do not differ ($P = 0.05$) according to Duncan's Multiple Range Test

Table 2. Nutrient content (%, DW for N, P, K, Ca, Mg and mg/l, DW for Mn, Fe, Zn) of bark samples taken from cuttings of twelve peach cultivars

	N		P		K		Ca		Mg		Mn		Fe		Zn	
Early Crest	1.56[a]	bc[b]	0.153	a	0.721	a	2.484	a	0.125	a	22.10	c	88.52	d	22.34	b
May Crest	1.38	g	0.136	c	0.686	ab	2.132	b	0.120	a	26.50	ab	100.26	c	22.05	b
Flavor Crest	1.58	ab	0.114	e	0.596	c	2.128	b	0.120	a	15.14	e	87.1	d	17.44	cd
Sun Crest	1.62	a	0.151	a	0.634	bc	2.417	a	0.130	a	18.48	d	84.26	de	25.27	a
Fayette	1.62	a	0.125	d	0.619	bc	2.108	b	0.125	a	16.34	de	95.74	cd	22.26	b
Katerina	1.48	de	0.113	e	0.582	c	1.880	c	0.081	c	28.56	a	79.11	e	16.84	d
Loadel	1.43	efg	0.148	ab	0.529	d	2.154	b	0.130	a	25.17	b	114.42	b	22.16	b
Andross	1.52	cd	0.142	bc	0.480	d	1.952	c	0.125	a	22.08	c	58.49	g	18.66	c
Everts	1.54	bc	0.136	c	0.487	d	2.102	b	0.125	a	17.88	de	83.55	de	22.42	b
May Grand	1.39	g	0.141	bc	0.588	c	1.935	c	0.125	a	25.04	b	122.13	a	18.16	c
Fire Bright	1.46	ef	0.145	b	0.579	c	1.913	c	0.116	b	26.64	ab	68.52	f	17.85	c
Fairlane	1.41	fg	0.15	a	0.584	c	2.075	b	0.128	a	24.99	b	101.32	c	13.58	e

[a] Each value is the mean of two experiments, each with six barks (replications)
[b] The values in each column with the same letter do not differ ($P = 0.05$) according to Duncan's Multiple Range Test

Samples of the cuttings (50 g fresh bark) were dried in a forced-draught oven at 70ºC for mineral element analysis. The concentrations of Ca, Mg, K, Zn, Mn, Fe and K in cuttings were measured on a Perkin Elmer 2380 atomic absorption spectrophotometer. Phosphorus was determined by the vanadomolybdophosphoric yellow colour method, and total nitrogen by Kjeldahl digestion and titration using a Kjeltec 1030 Auto Analyzer.

The rooting responses of the cuttings (expressed as percentages) were recorded 60 days after planting. Besides, the percentage of leaf fall at the time of cutting collection was recorded.

The experimental design used throughout the experiments was completely randomised. Data were analysed by one-way analysis of variance (ANOVA). To combine experiments, Bartlett's test of homogeneity of variance was used and treatment means were separated by Duncan's Multiple Range Test ($P = 0.05$).

RESULTS

There were significant differences in the rooting percentage between the peach cultivars. May Grand, Loadel, Fairlane, Andross and Fire Blight had relatively high rooting percentages while the cultivars Sun Crest, Early Crest, Fayette and Flavor Crest rooted rather poorly (Table 1). Katerina, Everts and May Crest had medium rooting percentages.

The leaf drop percentage of each cultivar during cutting collection is presented in Table 1. Sun Crest, Flavor Crest, Early Crest and Fayette had the highest percentage of leaf drop while May Grand, Fairlane, Katerina, Everts and May Crest had the lowest percentage.

There were significant differences in the mineral element content between the cultivars. Bark nitrogen was relatively high for Sun Crest, Fayette, Early Crest and Flavor Crest and low for May Crest, May Grand, Loadel and Fairlane (Table 2). Phosphorus content was relatively high for Fairlane, Loadel, Sun Crest and low for Katerina, Flavor Crest and Fayette. Potassium was relatively high for Early Crest, May Crest, Sun Crest, and Fayette and low for Andross and Everts. The calcium level was high in the bark of Sun Crest and Early Crest. The magnesium content of cuttings was similar for most cultivars. Manganese was relatively high in Katerina, Fairlane, May Grand and Fire Bright, and low in Flavor Crest, Sun Crest, Fayette and Andross. Zinc was relatively high in Sun Crest, Fayette, Early Crest, May Crest, Loadel, and Everts, and low in Fire Bright, May Grand, Fairlane, Flavor Crest and Andross. Finally, iron was high in May Grand, May Crest, Loadel and Fairlane, and low in Andross Fire Bright and Katerina.

DISCUSSION

It became apparent during the experiments that rooting is strongly affected by natural leaf drop occurring during cutting collection. Observations carried out during sampling showed that cultivars with more than 80% leaf drop had lower rooting percentages than cuttings from cultivars with leaf drop between 44 to 75%, and that generally, the peaks of leaf drop coincided very closely with low rooting. There are at least two possible effects: leaf fall coincides with the maximum transfer of carbohydrates and other materials, such as mineral nutrients, from senescing leaves into the bark, buds and perhaps roots of the tree; or leaf fall can reduce the upward flow of material such as mineral nutrients from the roots in the transpiration stream. The present experiments could only point to the effects, but more specific effects could only be elucidated by further experimentation. This study showed a relation between leaf drop and mineral nutrients that could influence the rooting of cuttings. It can explain the poor rooting of Sun Crest, which had quite good rooting in other experiments (TSIPOURIDIS unpublished).

Root initiation involves dedifferentiation of specific cells leading to the formation of root meristems (HARTMANN, KESTER 1975) in the presence of auxin (HAISSING 1972). If such is the case, then it would be expected that the aspects of general physiological activities must be implicated, and this would include nutrients involved in the multitude of metabolic processes associated with differentiation and root meristem formation, which is essential for root initiation. The relative importance of particular nutrients for adventitious rooting is relatively low, and is concerned with examining the mobilization or redistribution of mineral nutrients within the cutting during rooting. HARTMANN and KESTER (1975) clearly pointed to the role of mineral nutrients in root initiation. On the other hand, BLAZICH and WRIGHT (1979) and BLAZICH et al. (1983) reported no mobilization of N, P, K, Ca and Mg from the upper portions in stem cuttings of Japanese holly *Ilex crenata* Thub cv. Convexa nor movement into the stem base during root initiation. No adventitious roots developed on cuttings of pelargonium in Ca-deficient solutions (MIKESELL 1992). It was found that excess nitrogen application inhibits the rooting of cuttings (BATTIN 1990; HENRY et al. 1992). Conflicting results on the mobilization of particular nutrients during root initiation can somehow be related to species differences. Nevertheless, lack of mobilization should not exclude the need for a particular nutrient since some nutrients, such as Ca, are considered immobile in any case (MENGEL, KIRKBY 1982). Therefore data from the studies that attempt to correlate rooting with the contents of particular mineral elements in the stock plant can still be relevant.

Overall, there seems to be no clear-cut relation between rooting and contents of the major and some minor mineral elements. The only exception seems to be Fe and N. The data shown in Table 2 indicate that there is a relation between the Fe and N content of cuttings and their rooting. The peaks of Fe content coincide with the peaks of rooting. In contrast, the peaks of N content coincide with the lowest percentages of rooting.

It is possible that the differences in rooting percentages between the peach cultivars are due to different nitrogen and iron contents of the cuttings. These differences are possibly due to different percentages of leaf drop and phenological phases of stock plants.

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Vliv přirozeného opadu listů a stavu výživy matečné rostliny na zakořeňování řízků broskvoní

ABSTRAKT: Studium ukázalo, že zakořeňování dřevitých řízků bylo silně ovlivněno přirozeným opadem listů, ke kterému došlo během odběru těchto řízků. Pozorování během odběru vzorků ukázala, že v případě odrůd, u kterých opadlo více než 80 % listů, došlo k nižšímu procentu zakořeňování řízků než u řízků odebraných u odrůd s opadem listů v rozmezí 44–75 %. Fáze nejintenzivnějšího opadu listů těsně souvisela s nízkým procentem zakořeňování. Kromě toho bylo zjištěno, že existuje vztah mezi obsahem železa a dusíku v kůře řízků a jejich zakořeňováním. Nejvyšší obsah železa koreluje s nejvyšším a naopak nejvyšší obsah dusíku s nejnižším procentem zakořeněných řízků. Naproti tomu nebyly zjištěny žádné definovatelné vztahy mezi intenzitou zakořeňování a obsahem P, K, Ca, Mg, Mn a Zn.

Klíčová slova: živiny; dřevité řízky; broskvoně; odrůdy; zakořeňování

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