LEACHING OF NUTRIENTS FROM CUTTINGS UNDER MIST*

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Introduction

Mist propagation is not a strange term to the International Plant Propagators' Society. In the past 25 years the development of mist has enabled the propagator to root softwood, semihardwood, and many other difficult to root cuttings of various plant species. By spraying water into the air and maintaining a film on the cuttings themselves, transpiration is reduced. In this way, the turgidity of the cutting is maintained which is essential for root formation. But by allowing water to come in contact with the surface of the cuttings, leaching of organic and inorganic nutrients from within the plant tissue can occur.

Leaching of metabolites from intact plants has long been recognized. A great diversity of organic and inorganic materials can be leached from a wide range of plant species, and these losses are influenced by many factors (Tukey 1962). Many workers have published evidence that the mineral nutrient content of cuttings was lowered due to the leaching effects of mist during the rooting period (see Tukey, 1962). Sharpe (1955) showed that softwood cuttings of peach, grape, and blueberry all lost considerable amounts of nitrogen, phosphorus, and potassium and these losses were dependent upon the amount of mist used. Symptoms characteristic of nutrient deficiencies have been developed in cuttings under mist, suggesting that nutrients can be leached (Sweet and Carlson, 1955).

This paper is a survey of the leachability of several plant species propagated by cuttings under mist, as influenced by the maturity of the cuttings.

Materials and Methods

The plant material used in the study included herbaceous cuttings of *Chrysanthemum morifolium, Coleus blumei, Dianthus,* and *Euphorbia pulcherrima,* and woody cuttings of *Euonymus alatus, Euonymus fortunei* 'Vegetus,' *Ligustrum ibolium, Lonicera tatarica, Ribes alpinum, Pyracantha coccinea* 'Lalandii,' and *Forsythia intermedia.*

Forty uniform cuttings of each species were selected either in June or in September. Twenty cuttings were immediately dried, weighed, and analyzed in the laboratory for nitrogen, phosphorus, potassium, calcium, and magnesium, and in the case of *Chrysanthemum morifolium,* for soluble carbohydrates. Another twenty cuttings were placed in clean quartz sand under a distilled water mist until they were rooted, and then they were dried, weighed, and analyzed.

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Results

Many workers have reported losses by leaching as a per cent of the dry weight of the cuttings (Tukey, 1962). This is valid only if there is little or no growth during the rooting period. In these experiments (Table 1), it was noted that herbaceous and softwood cuttings taken in June did grow during the rooting period. For example, the dry weight of *Chrysanthemum morifolium* increased almost 3 times the original weight during the rooting period, while *Ribes alpinum* and *Euonymus alatus* had an increase of 50 per cent. Thus, to be more precise, leaching losses from cuttings growing during the misting period should be expressed as the total amount of nutrient leached.

On this basis, the nutrient contents of *Chrysanthemum morifolium*, *Ribes alpinum*, and *Euonymus alatus*, both before and after rooting are presented in Table 1. The total amount of the nutrients remained essentially unchanged during the rooting period for both *Chrysanthemum* and *Ribes* and differed only slightly for *Euonymus*. This indicates that little if any of the nutrients were leached by the mist, with the exception of potassium from *Euonymus*.

Table 1. Nutrient Content and Dry Weight of Softwood Cuttings Propagated Under Intermittent Mist.

Species	Dry weight*	Nutrient Content				
		N	P	K	Ca	Mg
	(g/cutting)	(mg / cutting)				
Chrysanthemum morifolium						
Before Rooting	.70	25.3	4.1	25.4	8.4	3.1
After Rooting	1.97	25.8	4.8	28.2	9.8	1.3
Ribes alpinum						
Before Rooting	.67	15.6	1.9	10.9	9.7	1.2
After Rooting	1.08	16.8	1.6	8.6	8.6	1.6
Euonymous alatus						
Before Rooting	1.00	23.1	2.5	9.3	53.0	3.2
After Rooting	1.49	21.6	1.8	1.3	49.0	2.7

*Increase in weight during rooting due to carbohydrate increase.

It has also been reported that organic as well as the inorganic nutrients can be leached from plant tissues (Tukey, 1962). Accordingly, chrysanthemum cuttings were analyzed for the total soluble carbohydrates both before and after they were rooted under mist. The results showed that the cuttings contained 191 milligrams of soluble carbohydrate per cutting before they were rooted and 830 milligrams after they were rooted, more than a four-fold increase during the rooting period. However, an analysis of the leachate from these cuttings showed that only 0.1 milligram of soluble carbohydrate was leached from these cuttings.

From these data it can be seen that cuttings which are young and actively growing do not lose appreciable quantities

of metabolites through the leaching action of mist. This is in accord with research with intact plants in which very young leaves of plants are often relatively difficult to leach (Tukey, 1962).

It was also reported that leaching of nutrients increased as leaves became older, suggesting that cuttings of mature wood might be more susceptible to leaching than would cuttings of immature wood.

The results of this study are presented in Table 2. Cuttings of *Pyracantha coccinea* 'Lalandii' and *Euonymus fortunei* 'vegetus' did not lose appreciable amounts of nutrients by leaching. However, these two species were not dormant, but rather were still growing in a greenwood condition and they responded to mist just as did those cuttings which were taken in the spring. However, the results for hardwood cuttings of *Forsythia intermedia* and *Ribes alpinum* showed a different picture. The nutrient content of these cuttings after rooting was considerably less than before rooting, due to leaching.

Table 2. Nutrient Content of Semi-hardwood and Hardwood Cuttings Propagated Under Intermittent Mist.

Species	Nutrient Content N	P	K	Ca	Mg
	(mg / cutting)				
Pyracantha coccinea 'Lalandii'					
Before Rooting	14.2	0.9	8.2	12.2	1.6
After Rooting	14.4	0.9	7.5	8.9	1.8
Euonymous fortunei 'vegetus'					
Before Rooting	29.0	4.1	12.6	63.5	4.1
After Rooting	26.9	3.3	12.1	62.8	5.4
Forsythia intermedia					
Before Rooting	21.5	2.6	13.0	16.7	3.8
After Rooting	20.9	1.6	9.9	11.4	0.9
Ribes alpinum					
Before Rooting	13.6	2.7	10.5	12.4	1.6
After Rooting	11.7	1.8	6.6	8.3	1.7

Table 3. Leaching of Nutrients from *Ribes alpinum* Cuttings Propagated Under Intermittent Mist as Influenced by the Maturity of the Cuttings.

Cutting Maturity	Nutrient Content N	P	K	Ca	Mg
	mg / cutting)				
Softwood					
Before Rooting	15.6	1.9	10.9	9.7	1.2
After Rooting	16.8	1.6	8.6	9.4	1.6
Nutrient Leaching	-	-	2.3	-	-
Hardwood					
Before Rooting	13.6	2.7	10.5	12.4	1.6
After Rooting	11.7	1.8	6.6	8.3	1.7
Nutrient Leaching	1.9	0.9	3.9	4.1	-

A more direct comparison of the influence of cutting maturity on leaching is given in Table 3, which compares losses by leaching from cuttings taken in June with cuttings taken in September. Softwood *Ribes alpinum* cuttings retained their nutrients, with the exception of potassium, whereas hardwood cuttings had a considerable portion of the nutrient content leached by the mist.

Discussion

The results of these experiments demonstrate that loss of nutrients by leaching from cuttings is influenced by the maturity of the cuttings. Mature hardwood cuttings were much more susceptible to leaching than were the rapidly growing softwood and greenwood cuttings. It is interesting to speculate that this may be another factor in explaining why softwood cuttings do so remarkably well under mist as compared with hardwood cuttings.

It has been reported that nutrient deficiency symptoms develop in some plants propagated under mist. In the case of the hardwood cuttings, this could be due to leaching from the cuttings. However, in the case of herbaceous cuttings, the nutrients in the cuttings were diluted by the large increase in growth during the rooting period. Additional nutrients are not available to the cuttings and thus deficiency symptoms develop in the new growth.

These results suggest that applications of nutrients through the mist during the rooting period would be of benefit to the cuttings, as shown by Boodley and Morton (1962). Nutrient mist would replace nutrients which were leached and would supply nutrients for new growth during rooting.

Summary

Young, vigorously growing cuttings propagated under mist did not lose considerable amounts of nutrients by leaching. The mineral deficiencies observed in the plants were apparently caused by a dilution of the original nutrients by additional carbohydrates as a result of growth. More mature cuttings which were not growing during the rooting period lost considerable amounts of nutrients to the leaching action of the mist. Mineral deficiencies which developed in these cuttings were apparently due to losses of nutrients by leaching. It would appear that nutrients added to the cuttings through the mist would be of benefit to both herbaceous and softwood as well as hardwood cuttings.

REFERENCES

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MODERATOR BORK: I will now turn the program over to President Roller.

PRESIDENT ROLLER: Dr. Waxman has an announcement.

DR. WAXMAN: I would like to remind you all that tonight is the question box. The question box is on the registration desk.

ROY NORDINE: The annual dinner meeting for the Botanical Gardens, arboretum, and university people will be held tonight. We will meet in the lobby at 5:45.