

Experiences with Carbon Dioxide Enrichment for Production of Rooted Cuttings

Willem Sanders

Sanders Nurseries, Halve Raak 46, 2771 AD Boskoop, Netherlands

INTRODUCTION

Trials at the Research Station for Nursery Stock at Boskoop have already shown that carbon dioxide (CO₂) enrichment has a positive effect on rooting and growth of cuttings, particularly rooting percentage and fresh and dry weight (Table 1). In 1992 these positive results from the Research Station encouraged Sanders Nurseries to invest in CO₂ enrichment equipment and to use it in all propagation. The technique has proved to be very beneficial for this nursery and has never given negative results, though sometimes there has been no difference between use and non-use of CO₂ enrichment.

When producing cuttings under low polythene covers, if there is no CO₂ enrichment, carbon dioxide levels under the polythene may drop below the threshold for plant growth. For example, measurements at Willem Sanders Nurseries on 1 day in March showed 3000 ppm CO₂ under the polythene produced by plant respiration during the night. The day started with fog but the sun broke through between 9 AM and 9:30 AM. Within 1 h the CO₂ level fell from 3000 ppm to 75 ppm, which is below the CO₂ level needed for growth of the cuttings. At this point the cutting will be metabolising its own stored energy reserves, if it has any. In such weather conditions some CO₂ generating equipment may not be able to generate enough CO₂.

CARBON DIOXIDE ENRICHMENT REGIME

On this nursery cuttings are rooted under close polythene film. For the first 2 weeks condensation (or traditional) film is used. As soon as good callus is seen the film is lifted approximately 10 cm. From now on, anti-condensation film is used in order to obtain more light and better humidity around the cuttings. As there is now more air volume around the cuttings, computer controlled injection of carbon dioxide to generate up to 800 ppm CO₂ is started.

Qualitative observation on the nursery has shown that cuttings remain in a much better condition with reduced incidence of fungal infection when CO₂ enrichment is used. For example, the leaves of *Magnolia*, *Rhododendron*, and *Camellia* cuttings are greener and healthier. Blue conifers start growing a little before rooting and the young shoots are very blue and healthy. The cuttings do not seem to start rooting earlier, but when they do root, rooting is more simultaneous across the crop and each cutting produces more roots.

EARLY ERRORS IN USING CO₂ AT SANDERS NURSERIES

At first, when anti-condensation film was used during the CO₂ enrichment phase, there was too much light in summer for some taxa. For example many *Photinia* and *Pieris* cuttings were lost. Now the anti-condensation film is covered with fleece in summer to obtain better balanced rooting conditions.

Table 1. Summary of significant effects of CO₂ and light and significant interactions of four experiments in the period 1991-1993 on rooting percentage, number of roots, and fresh and dry weight (with permission, Research Station for Nursery Stock, Boskoop).

Date	Plant	Effect																
		Light						CO ₂						Interaction				
		%	N	F	D	%	N	F	D	%	N	F	D	N	F	D		
Sept 91	<i>Juniperus scopulorum</i> 'Skyrocket'		++				++	+++	+++	+++								
	<i>X Cupressocyparis leylandii</i>					+	++	+++	+++	+++								
	<i>J. chinensis</i> 'Plumosa Aurea'		+			+++												
	<i>J. horizontalis</i> 'Wiltonii'		--			+++	+++	+++	+++	+++						*		
Sept 92	<i>J. scopulorum</i> 'Skyrocket'		+++		+++	+	+++	+++	+++	+						*		
	<i>X C. leylandii</i>			+	+++		++	+++	+++	+++					*	**	*	
	<i>J. squamata</i> 'Blue Star'		+	+	++	+++	++	++	+++	+++								**
	<i>X C. leylandii</i> 'Golden Triumph'		--	--												*		
Feb 93	<i>J. scopulorum</i> 'Skyrocket'		+	+	++	+	++	+	+	+								*
	<i>X C. leylandii</i>		-		++													
	<i>J. chinensis</i> 'Plumosa Aurea'		-		+	+												
	<i>X C. leylandii</i> 'Golden Triumph'		-															
Sept 93	<i>X C. leylandii</i>		+		+											**		
	<i>J. chinensis</i> 'Plumosa Aurea'				++													

1 Abbreviations and symbols: rooting percentage (%), number of roots (N), fresh (F) and dry weight (D); + means a positive effect of the factor (p<0.05), ++ means a positive effect (p<0.01), +++ means a positive effect (p<0.001), -(-) means a negative effect, and *(**) for interaction effects.

In some cases the concentration of rooting hormone was reduced because the cuttings grown under CO₂ enrichment are more active and produce more of their own auxins.

SITUATIONS WHERE CO₂ ENRICHMENT MAY NOT BE OF BENEFIT

When cuttings are rooted in large volumes of peat, for example in deep open trays or beds rather than in cell trays, CO₂ is produced through the composting activity in the peat so enrichment is not necessary.