Effect of Lowered Light Quality (R:FR Ratio) at Targeted Organs on Branching of Trifolium Repens

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EFFECT OF LOWERED LIGHT QUALITY (R:FR RATIO) AT TARGETED ORGANS ON BRANCHING OF TRIFOLIUM REPENS

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ABSTRACT
This report examined results from four similarly conducted experiments using *Trifolium repens* in which the R:FR ratio but not the photosynthetically active radiation (PAR) of incident light was altered at specific organ(s) of several successive phytomers or just at a single phytomer. Results indicate the local response to lowered R:FR light treatment was similar irrespective of the number of phytomers treated. This response pattern provides the means whereby plants can initiate strong localised responses to a heterogeneous light environment.

KEYWORDS
White clover, R:FR ratio, branching, axillary buds, light-emitting-diodes

INTRODUCTION
Branching (development of an axillary bud to form a new shoot meristem) is a key process determining the success of clonally growing white clover (*Trifolium repens* L.). The branching process is known to be sensitively controlled by both the quality and quantity of incident light (Solangaarachchi and Harper, 1987; Thompson and Harper, 1988). To further understand the role of light quality (red:far-red ratio; R:FR) on branch development and identify the sites of photoperception a series of experiments were performed in which the R:FR ratio but not the PAR of incident light at specific organs was altered (Robin *et al*., 1994a, b). These experiments either targeted a specific organ(s) at several successive phytomers or at a single phytomer. The aim of this report is to assess whether the intensity of response altered when treatments were imposed at several as opposed to a single phytomer as this issue has implications for the understanding of the extent of physiological integration involved in plant responses to heterogeneous light environments.

MATERIALS AND METHODS
All experiments used clonal cuttings of the same single genotype (cv. Kopu, AgResearch clone 131) and the same containers and soil mix (Robin *et al*., 1994a, b). The experiments were performed in a controlled environment room with PAR 280-300 (μmol $m^{-2}s^{-1}$, photoperiod 10h, relative humidity 75%. In experiments 1 and 2 room light R:FR ratio was 1.6 and for experiments 3 and 4, 1.2. Day/night temperatures were 21/18°C for experiments 1, 2 and 3 and 17/12°C for experiment 4.

In all experiments localised differences in light quality were achieved using FR (also R in Expt. 1) light-emitting diodes to supplement the white light of the growth room. Collimators and shields were used to ensure only the target organs were exposed to the localised light treatment (see Robin *et al*., 1994a, b for details). Table 1 details the organs treated in each experiment and indicates whether treatments were at a single phytomer or at several successive phytomers.

RESULTS AND DISCUSSION
In experiments 1 and 3 the light treatments were applied for 29 d during which time 9 leaves (phytomers) emerged from the apical bud of the main stolon. Reduced R:FR light at the apical bud delayed the outgrowth of axillary buds by 0.5 plastochrons in both experiments. The FR treatments of each successive leaf as it unfolded induced the same delay.

Experiments 2 and 4 were designed to treat either the axillary bud or the leaf at a single phytomer. The axillary bud was unresponsive to lowered R:FR light when treated after emergence from the apical bud. However exposure of the unfolding leaf to lowered R:FR light delayed outgrowth of the subtending axillary bud by 0.3 plastochrons. Lowered R:FR light applied to a leaf after it had fully unfolded significantly reduced the node appearance rate of the branch it subtended.

The response pattern observed ensures that plants of this plagiotropic species can make strong local responses to the heterogenous light environment commonly experienced in the field.

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Table 1
Effect of variation in R:FR ratio of incident light on targeted organs, either at successive phytomers or at a single phytomer, on branch development. PAR was uniform for all organs; R:FR ratio was manipulated by supplying FR light from small diodes. (Delay in branch outgrowth relative to control given in plastochrons).

Treatments targeted to organs at		**Experiment Number**										
		1			**2**			**3**			**4**	
Successive phytomers	Target Organs	R:FR	Delay in branching				Target Organs	R:FR	Delay in branching			
	Apical Bud	2.1	0				*Unfolding leaves*	0.3	0.5			
		1.6	-				*Apical Bud*	0.3	0.5			
		0.25	0.5				*Control*	1.2	-			
A single phytomer				Target Organs	R:FR	Delay in branching				Target Organs	R;FR	Delay in branching
				Axillary bud in the apical bud and after emergence	0.27	0.8				*Unfolding leaf*	0.3	0.3
				Axillary Bud after emergence	0.27	0				*Unfolded leaf*	0.3	0*
										Axillary bud	0.3	0
						-						-
				Control	1.7					*Control*	1.2	

* reduced node appearance rate