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Some aspects of bud activity and branch formation in young oak

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Introduction

This work forms part of a programme to improve the genetic quality of oaks planted commercially; some of this project is based on the vegetative propagation of selected superior genotypes. For this selection programme to be successful, it must be possible to predict future development of the trees. This is particularly important when considering selection at the juvenile, seedling or sapling stage, when plants are more readily propagated but of unknown potential.

Epicormic branches, poor stem form and the unfavourable ratio of crown and trunk biomass are important characters determining the quality of a crop. Favourable changes in these will have a marked effect on value. They are probably interrelated phenoma resulting from bud production, bud activity and branch growth. Detailed data on these aspects of growth are few but this information is essential for the development of procedures for early testing. The following experiments investigated the effect of nitrogen nutrition and bud position on the formation of branches in *Quercus petraea* seedlings.

Terminology

Shoot extension in oak occurs by rapid growth from a preformed bud. The distribution of leaves and buds on the shoots produced in each flush is uneven. In this study, axillary bud density was *ca* 1 bud/20 mm length for most of the shoot but increased to *ca* 1 bud/2 mm at the tip: the dense terminal rosette of leaves and buds of each flush is termed the 'whorl' and the remaining longer section of shoot, the 'interwhorl' stem (Fig. 1).

Mineral Nutrition

In spring 1986 dormant 1 yr old seedlings of *Q. petraea*, which had flushed twice but not branched, were decapitated below the 1st whorl (see Fig. 1) and planted into 15 cm pots of peat–sand–perlite. Plants were grown in an unheated greenhouse and fertilised at weekly intervals with a liquid feed containing either 1 or 10 mM sodium nitrate, these were low N and high N plants, respectively. There were 40

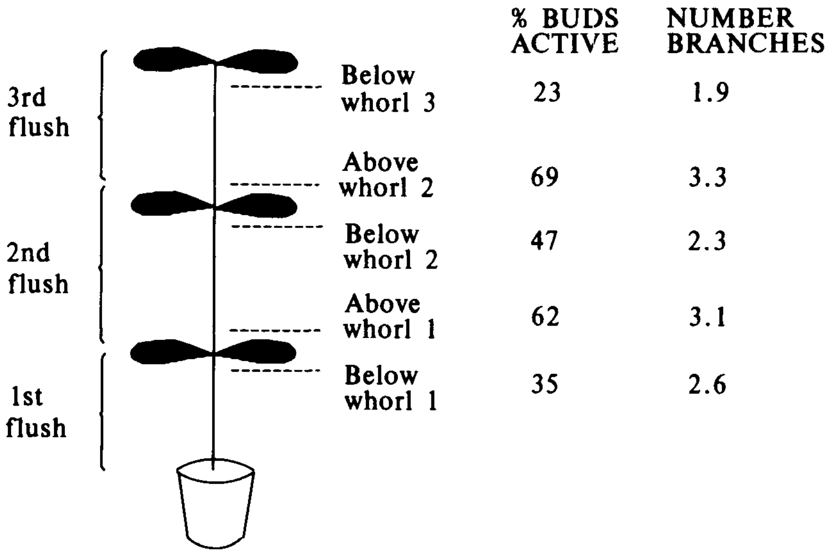

Fig. 1. Branch formation in decapitated *Q. petraea.*

replicates of each treatment. The number of axillary buds and branches which formed within the whorl and on the interwhorl stem of each flush was counted on several occasions during summer.

High N plants were more vigorous than low N plants producing longer shoots with more buds and branches than low N plants.

Most high N plants flushed 3 times during growth, whereas most low N plants flushed only twice (Table I). All plants produced 2 branches during the 1st flush of growth but in subsequent flushes high N plants produced 2–3 times more than low N plants (Table I).

The number of buds forming branches as a percentage of the total number in whorls and on interwhorl stems for the 1st and 2nd flushes of growth are shown in Table II. The values were always <50%, indicating that more buds remained dormant than turned into branches. No 2nd flush whorl buds formed branches on low N plants. Figures for low N plants were always less than high N plants showing that proportionately fewer buds became branches on low N plants.

Table I. Mean number of new branches produced in each flush.

	Mean no. flushes	*1st flush*	*2nd flush*	*3rd flush*
High N	2.9	2.6	4.0	4.6
Low N	2.3	2.5	2.6	1.7
	***	NS	***	***

*** $P \leq 0.001$.

Table II. Percentage number of buds forming branches.

	1st flush		*2nd flush*	
	stem buds	*whorl buds*	*stem buds*	*whorl buds*
High N	6	17	5	8
Low N	1	3	1	!*

* No whorl buds formed branches in the 2nd flush.

Position of bud

Acorns were planted in 10 cm pots of 3:1 peat–grit and placed in a heated greenhouse with 18 h day length; plants were treated at 14 day intervals with 8:4:4 NPK liquid fertiliser. After 3 flushes of growth, plants were decapitated at the sites shown in Fig. 1. There were 15–20 replicates for each treatment. The number of branches formed on each interwhorl stem and whorl were counted after reflushing had occurred.

Growth was acrotonic and new branches were only produced on the whorl or interwhorl stem immediately below the decapitation cut. The percentage number of buds active in plants decapitated above a whorl was greater than those decapitated below a whorl (Fig. 1). Although there were more buds on interwhorl stems, most branches were formed in whorls (Fig. 1).

Field observations showed a similar result: whorls produced 3 times as many branches as interwhorl stems and application of NPK fertiliser doubled the number of branches produced.

These results are reflected in the intact plants from the nutrition experiment where proportionately more whorl buds (*i.e.*, smaller percentages, Table II) formed branches than interwhorl stem buds.

Conclusion

The potential to form branches varied between buds and different parts of the shoot; whorl buds were more likely to produce branches than interwhorl stem buds. Most buds remained inactive but the number which developed into branches was influenced by mineral nutrition of the plant; a high nitrogen regime was associated with more branch production. If decapitation tests can be used for the early selection of oak (Leakey, 1986), it will be important to control mineral nutrition: more difficult is the requirement to define criteria for the location of decapitation cuts.

References

Leakey R.R.B. (1986) Prediction of branching habit in clonal *Triplochiton scleroxylon. In: Crop Physiology of Forest Trees* (Tigerstedt P.M.A., Puttonen P. & Koski V., eds.), University of Helsinki, Finland, pp. 71-80