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A Study of the Growth of Axillary Buds in Angiosperms

A Dissertation Presented in Partial Fulfilment of the Requirements for the
Degree of Master of Science in Botany at Massey University

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Abstract

A description of the growth of axillary buds in the period before bud break was made in a number of angiosperms. This entailed a study of the growth of buds at representative locations in a plant as well as at different stages in the plant's growth. A number of different patterns of axillary bud development were found to exist. A way of assessing the significance of the differences between patterns was found. This involved comparing the observations with the theoretical possibilities which existed. A loose classification of the patterns was then constructed using the theoretical possibilities as a basis. An analysis of the data for each species was carried out to see if a cause for the **cessation** of bud growth could be determined. This analysis pointed towards the existence, in a large number of species, of a correlation between growth in an axillary bud and growth in surrounding tissues, particularly the expanding subtending leaf. One species - *Salix fragilis* - was chosen as the subject for a particularly detailed analysis. A clear correlation was established between growth in an axillary bud and growth in the stem in the immediate vicinity of the bud as well as in its subtending leaf. A number of experiments aimed at finding out the nature of a correlation between growth in an axillary bud and its subtending leaf were carried out with this species. These demonstrated that removal of a subtending leaf at an early stage in its growth had a significant depressing effect on axillary bud growth. This depressing effect was most pronounced during the period of most rapid growth in the axillary bud and its subtending leaf.

The data from the general survey of over thirty plant species and the experiments with *Salix fragilis* seem to support the notion that the process of axillary bud growth - as opposed to that of lateral shoot outgrowth **from** axillary buds - is affected more by conditions within the growing stem than by influences exerted by the stem apex.

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Contents

| | Page |
|---|------|
| Acknowledgements | iii |
| List of Figures | v |
| Chapter 1: Introduction | 1 |
| Chapter 2: A Survey of the Different Patterns of Axillary Bud Growth in Angiosperms | 25 |
| Chapter 3: Rate of Leaf Primordium Initiation in Axillary Buds Relative to the Rate of Initiation of Leaf Primordia in the Shoot Apex | 34 |
| Chapter 4: Axillary Bud Growth Patterns | 39 |
| Chapter 5: Correlations | 60 |
| Chapter 6: Investigation of the Effect of Removal of Subtending Leaf Primordia on Axillary Bud Growth in <i>Salix fragilis</i> | 69 |
| Chapter 7: An Analysis of the Distribution of Photosynthate in a Shoot Apex of <i>Salix fragilis</i> | 89 |
| Chapter 8: Discussion | 101 |
| Appendix: Section 1 | 106 |
| Section 2 | 194 |
| Bibliography | 199 |

List of Figures and Plates

| | | Page |
|----------|--|------|
| FIG. 1.1 | Drawings of a stem apex of <i>Salix fragilis</i> . | 11 |
| FIG. 1.2 | Axillary bud initiation within the apical bud of <i>Salix fragilis</i> . | 12 |
| FIG. 1.3 | Axillary bud growth in <i>Salix fragilis</i> . | 13 |
| FIG. 1.4 | Two sets of graphs of the number of leaf primordia per axillary bud plotted against node number in <i>Salix fragilis</i> . | 16 |
| FIG. 1.5 | <i>Stachys sylvatica</i> . Drawings showing the structure of a shoot and the sylleptically developing axillary bud or shoot. | 17 |
| FIG. 1.6 | Drawings of an axillary bud in <i>Ulmus procera</i> ; bud development in this species is proleptic. | 20 |
| FIG. 1.7 | Comparison of leaf position with total leaf length and prophyll length for a single plant of <i>Eichhornia crassipes</i> . | 24 |
| FIG. 2.1 | Documentation for a dissection of a shoot of <i>Lolium perenne</i> . | 30 |
| FIG. 2.2 | Graph of number of leaf primordia per axillary bud, length of longest axillary bud leaf primordium, and subtending leaf length against node number in a shoot of <i>Lolium perenne</i> . | 31 |
| FIG. 2.3 | Graphs showing the relationship between internode length below a node, and the length of the leaf at that node, in single shoots in four species. | 32 |

| | | |
|-----------|---|----|
| FIG. 2.4 | Graphs of internode length below a node, and leaf length, against node number in four species. | 33 |
| FIG. 3.1 | Simplified diagrams based on the growth curves of <i>Salix fragilis</i> , <i>Melicytus ramiflorus</i> and <i>Lolium perenne</i> . | 37 |
| FIG. 3.2 | Relative rate of leaf primordium initiation for a number of plant species. | 38 |
| FIG. 4.1 | Growth curves for <i>Helianthus annuus</i> . | 48 |
| FIG. 4.2 | Growth curves for <i>Stachys sylvatica</i> . | 49 |
| FIG. 4.3 | Growth curves for <i>Hebe speciosa</i> . | 50 |
| FIG. 4.4 | Growth curves for <i>Trifolium repens</i> . | 51 |
| FIG. 4.5 | Growth curves for <i>Salix fragilis</i> . | 52 |
| FIG. 4.6 | Growth curves for <i>Ulmus procera</i> . | 53 |
| FIG. 4.7 | Growth curves for <i>Aristotelia fruticosa</i> . | 54 |
| FIG. 4.8 | Growth curves for <i>Melicytus ramiflorus</i> . | 55 |
| FIG. 4.9 | Growth curves for <i>Muehlenbeckia australis</i> . | 56 |
| FIG. 4.10 | Growth curves for <i>Pittosporum crassifolium</i> . | 57 |
| FIG. 4.11 | Growth curves for <i>Lonicera x americana</i> . | 58 |
| FIG. 4.12 | Growth curves for <i>Sambucus nigra</i> . | 59 |

| | | |
|-------------------|---|----|
| FIG. 5.1 | <i>Salix fragilis</i> . Graphs of the number of leaf primordia per axillary bud, and the length of subtending leaves plotted against node number in four shoots. | 64 |
| FIG. 5.2 | <i>Hebe speciosa</i> . Graphs of the number of leaf primordia per axillary bud, and the length of subtending leaves plotted against node number in four shoots. | 66 |
| FIG. 5.3 | <i>Passiflora mollissima</i> . Graphs of the number of leaf primordia per axillary bud, and the length of subtending leaves plotted against node number in two shoots. | 67 |
| FIG. 5.4 | <i>Lycopersicon esculentum</i> . Graphs of the number of leaf primordia per axillary bud, and the length of subtending leaves plotted against node number in five shoots. | 68 |
| FIG. 6.1 to 6.4 | Graphs of the number of leaf primordia per axillary bud against node number for the calculation of growth depression in the leaf removal experiments. | 74 |
| FIG. 6.5 | Data from the leaf removal experiment. | 79 |
| FIG. 6.6 | Three dimensional graph for the leaf removal experiment. | 83 |
| FIG. 6.7 | Drawings of distorted axillary buds. | 84 |
| PLATES 7.1 to 7.5 | Photomicrographs of sections through an axillary bud of <i>Salix fragilis</i> . | 94 |

PLATES 7.6 to 7.9 Histoautoradiography experiment - photomicrographs of longitudinal sections through the apical region of a shoot in *Salix fragilis* into which radioactive carbon had been fed.

CHAPTER 1

Introduction

Growth in all but the simplest of plants depends on their ability to form branching structures. Branches can originate when the stem apex itself divides, as it does in lower vascular plants such as *Psilotum*, *Lycopodium* and *Selaginella* (Esau 1965), or from the outgrowth of lateral buds, laid down on the main shoot distal to the apex. These lateral buds are most frequently subtended by a leaf. In some ferns with dorsiventral rhizomes they seem to arise without reference to leaves, but it is more common for them to originate from or near to the adaxial side of a leaf base or rhachis (Esau 1965). The bulbils of *Lycopodium selago* occupy the sites where leaves are normally found (Cutter 1966).

In seed plants lateral buds - when present - are usually found in an axillary position, in other words on the stem just above the point of insertion of the leaf. Lateral buds are generally present in the axils of most leaves except those in the lower regions of annual shoots of some gymnosperms (Foster and Gifford 1974). In a few instances they are found in other than axillary positions - in species of *Nymphaea* and *Nuphar* occasional buds occur in what are normally leaf sites (Cutter 1965). Lateral buds in a number of species are associated more closely with the leaf above than the leaf below - the early slow growth of a tiller bud in the Gramineae involves the making of vascular connections with the leaf immediately above the bud. The later, exponential growth phase starts some time after the establishment of the vascular connection (Fletcher and Dale 1973; Sharman 1945).

In angiosperms, lateral buds are usually formed slightly later than subtending leaf primordia, commonly when such leaves are in their second or third plastochrone (Esau 1965). But in some species buds form much later by dedifferentiation of already vacuolated cells or from small pockets of meristematic cells - called **detached meristems** - which have become isolated from the apical meristem by differentiation of intervening tissues (Cutter 1971). Bud primordia may also arise adventitiously from various organs and tissues in the plant. Such a pattern is found in *Musa*: the earliest vascular connection of the lateral bud in this species is made, as in the grasses, with the trace of the next leaf above (Barker and Steward 1962). However, the lateral buds in the aforementioned cases are at least located in axillary positions. Indeed, lateral buds in angiosperms are usually referred to as **axillary buds**.