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DEVELOPMENTAL BIOLOGY OF FERN GAMETOPHYTES

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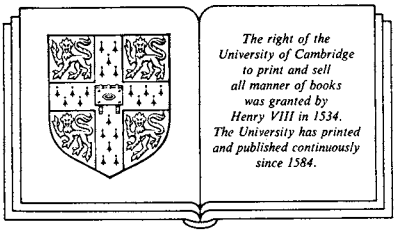

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For my wife Lakshmi and daughter Anita

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Preface

As the dominant phase in the life cycle of ferns and other pteridophytes, the sporophyte – the leafy fern plant with its characteristic foliage and growth habit – has received and continues to receive much attention in morphological, phylogenetic and evolutionary considerations, as well as in books and monographs. As a departure from this trend, the present book attempts to focus on the other phase of the fern life cycle – the unobtrusive gametophyte. Although slow to begin with, there has been a growing realization of the potentialities of the fern gametophyte for experimental studies, providing impetus for significant new inter-disciplinary research on its growth, differentiation and sexuality. Since no unified summary of these investigations comprising the entire gametophytic phase exists, it is the purpose of this book to present a brief, but comprehensive account of the developmental biology of fern gametophytes. This work is also an inevitable outcome of my own interest in the study of gametophytes for nearly a quarter of a century.

The overall philosophy of the book has been to present the story of the gametophyte in a familiar developmental sequence beginning with the single-celled progenitor, going to the multicellular state and ending with the initiation of the sporophytic phase. The content of each chapter is focused around the physiological, cytological and biochemical background of the topic under discussion. The morphology of the gametophyte is integrated throughout the text and is related, where appropriate, to the developmental biology of the system. Each chapter begins by introducing the basic ideas related to its theme and develops them with reference to specific experiments. This has meant drawing examples from a large number of experimental organisms. The subject matter of some chapters is wide-ranging, with several aspects of research serving as focal points for discussion. In writing these chapters, I have felt that the full force of the insight developed by these researches can become evident only by putting the pieces of information together, at the risk of increasing the bulk of the chapters.

I envision the book as an introduction, to beginners in botany, of the potentialities of this fascinating experimental system and as a major

reference work to those who are already working in the field. It is also my hope that this volume will be used as a supplementary text in courses in developmental botany dealing with model systems. In order to keep the book within reasonable bounds, no encyclopedic treatment has been attempted; indeed, most of the references cited represent papers published since 1950. In these days, when the data published in research papers are also found in the contributions to multi-authored volumes and symposia proceedings, I have relied on these latter sources only when the relevant information is not available in regular journal articles.

The binomials used in the book were referred to Drs John T. Mickel (New York Botanical Garden, New York) and Alan R. Smith (University of California, Berkeley) who were very generous with their time in checking the plant names and relating them to names now recognized as the valid ones. I am very appreciative of this help. Several other investigators have aided me in the preparation of this work by acceding to my request for original prints of photographs from their published papers. It is a pleasure to thank them for this help and the various authors and their publishers for granting me permission to use their illustrations in the book. I should also like to acknowledge the assistance of Drs Paul Green and Peter Barlow, two editors of the Developmental & Cell Biology Series, who read the first draft of the book and provided valuable comments for its scientific and stylistic improvement. Finally, I wish to pay tribute to my wife, Lakshmi, and daughter, Anita, for their encouragement and understanding, which prompted me to complete this book sooner than I expected.

V. Raghavan October, 1988

Abbreviations

ABA	Abscisic acid
AMP	Adenosine monophosphate
ATP	Adenosine triphosphate
ATPase	Adenosine triphosphatase
BUDR	5-Bromo-2-deoxyuridine
CCC	2-Chloroethylmethyl ammonium chloride
CEPA	2-Chloroethylphosphonic acid
CIPC	Isopropyl-N-3-chlorophenylcarbamate
DNA	Deoxyribonucleic acid
2,4-D	2,4-Dichlorophenoxyacetic acid
EGTA	Ethylene glycol-bis(β-amino-ethyl ether)-N,N,N′,N-tetraacetic acid
ER	Endoplasmic reticulum
FLU	5-Fluorouracil
GA	Gibberellic acid
IAA	Indoleacetic acid
IBA	Indolebutyric acid
ICL	Isocitrate lyase
MS	Malate synthase
NAA	Naphthaleneacetic acid
NOA	2-Naphthoxyacetic acid
PCIB	*p*-Chlorophenoxyisobutyric acid
P_r	Red-absorbing form of phytochrome
P_{fr}	Far-red absorbing form of phytochrome
$P_{b\text{-}nuv}$	Pigment absorbing blue and near UV light
Poly(A)	Polyadenylic acid
Poly(A) + RNA	Poly(A)-containing RNA
RNA	Ribonucleic acid
hnRNA	Heterogenous nuclear RNA
mRNA	Messenger RNA
rRNA	Ribosomal RNA
tRNA	Transfer RNA

RNase	Ribonuclease
SHAM	Salicyl-hydroxamic acid