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Gideon Ladizinsky

Studies in Oat  
Evolution  
A Man's Life  
with *Avena*



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# Studies in Oat Evolution

A Man's Life with *Avena*

 Springer

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ISSN 2211-808X                      ISSN 2211-8098 (electronic)  
ISBN 978-3-642-30546-7            ISBN 978-3-642-30547-4 (eBook)  
DOI 10.1007/978-3-642-30547-4  
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2012938868

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*Frontispiece: Avena insularis*

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*To my family*

# Preface

In 1964 I began a study on evolution and species relationships in the genus *Avena*. I could not imagine then that this journey would last for more than 45 years. The genus *Avena* is economically important as it contains the common oat which is grown for human consumption and animal feed and the slim, or sand oat, which is grown for fodder. The subject of my study, however, was the wild oat species because at that time these were not well understood compared to the other cereals and definitely when compared to the present knowledge. It is interesting to note that in addition to the accumulation of that knowledge, between 1967 and 1996, seven new species of wild oats were discovered—one by US oat workers, another three by Canadians, and three by me. I do not know of any other crop plant in which such botanical and genetic progress has been achieved over such a short period.

For about 20 years, from 1973 to 1994, besides my work on oats, I was intensively engaged in a study of the origin and wild relatives of the Middle East pulses, including broad bean, chick pea, lentil, fenugreek, common vetch, and bitter vetch. The work involved collecting wild relatives from various Geographical areas, a preliminary survey of their seed protein profile, performing intra- and interspecific hybridizations and chromosome pairing analyses of their hybrids, and establishment of methods for gene transfer from certain wild relatives to the domesticated forms. I refuted a hypothesis that the broad bean originated from the wild species *Vicia galilea* or any other species of Section *Faba*. I established crossability relations between the annual species of the genus *Cicer* and discovered the wild progenitor of chick pea in eastern Turkey. In the course on extensive studies of the genus *Lens*, I explored the areas and collected seeds where its wild relatives have been reported in Mediterranean countries, central Asia, Uganda, Ethiopia, and Morocco. These activities yielded two previously unknown species. In addition, following extensive hybridization experiments on the cytogenetic analyses of hybrids, I was able to establish evolutionary relationships between the various species. The use of embryo culture enabled me to hybridize species which otherwise are cross- incompatible. By employing characteristics that could not be selected or influenced by human, I showed that the wild lentil stock which gave rise to the domesticated lentil occurs in northern Syria and southern Turkey.

This small book resulted from conversations with oat specialists who were trained mainly as molecular biologists. They urged me to summarize my experience with oat and my insights and viewpoints regarding several evolutionary issues in that genus. I hope that future generations of oat scientists will benefit from this publication and will add further evidence to deepen our understanding of oat species origin and evolution.

**Chapter 1** of this book deals with the morphology and the taxonomy of the genus *Avena*. The morphological characteristics that are employed for identification of the various species are described and evaluated. Taxonomic treatments of the genus are briefly described and their advantages and drawbacks are pointed out. The species concept is discussed and the biological species type seems preferable over the classical morphological concept. Accordingly, a list of the *Avena* species is presented with a key for their identification and the description of each of them.

**Chapter 2** describes my research findings in the genus *Avena* from the initial steps of becoming acquainted with the various species, their morphological peculiarities, geographic distribution, and ecological preferences. Considerable effort has been devoted to study the relationships between diploids and tetraploids in Series Eubarbatae. By combined cytological and morphological evidence I successfully used the bristle length at the tip of the lemmas to separate diploids from tetraploids in living material and herbarium specimens and to determine the geographic distribution and the ecological preferences of each of them. While the origin of the tetraploid forms is believed to be through allopolyploidy, the evidence which I presented indicates an autopolyploid origin. In this chapter the newly described species in Section Eubarbatae are described and evaluated.

**Chapter 2** also deals with Section Denticulatae to which the common oat belongs. The process by which the genome designation of this hexaploid oat has been established is described and critically assessed and refuted. In this Section, several new species were described in the last 50 years, one of which appears to be the tetraploid progenitor of the hexaploid oats. The discovery of each of these species is briefly described.

Another section of this chapter deals with oat domestication and in particular the recent domestication of the protein-rich tetraploid wild oat *Avena magna*. The latter is a project I have been conducting for the last 25 years. Its purpose is to transfer the domestication syndrome of the common oat to this wild oat, thereby creating a new protein-rich tetraploid oat cultivar.

The last section deals with collecting wild oat species as genetic resources. While collecting wild oats is mentioned throughout the book; in this chapter the methodology which I have developed over 45 years is described.

I am indebted to Prof. Abbo Shahal and Dr. Mike Leggett for their valuable suggestions on the manuscript.



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