

R.E. Mullen

Crop Science

Principles and Practice



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Principles and Practice

Second Edition

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Ames, Iowa

A portion of the seed drawings used in Chapter Two were furnished courtesy of the Iowa State University Seed Science Center.

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ISBN 0-8087-4184-5

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Printed in the United States of America.

J I H G F E D C B

Address orders to:

BURGESS INTERNATIONAL GROUP, INC.

7110 Ohms Lane

Edina, Minnesota 55439-2143

Telephone 612/831-1344

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Acknowledgements

In dedication to Detroy Green and Donald Woolley... As books evolve and change so do authors. The present author is indebted to Dr. Detroy Green and Dr. Don Woolley, co-authors of the first edition of *Agronomy—Principles and Practice*. The present edition goes forth upon their foundation. Their contributions and friendship are greatly appreciated.

Gratitude is extended to the many colleagues, former and present graduate instructors, teaching assistants, and students who have provided invaluable ideas, assistance, and feedback upon which the former and present editions have depended.

The author is also indebted to colleagues who have served as reviewers and provided valuable suggestions for improvement of this edition: Mike Lauer, Pioneer Hi-Bred Int.; Brent Pearce, Dick Carlson, Tom Loynachan, Rick Cruse, Arden Campbell, Al Knapp, Mike Owen, John Obrycki, and Ed Braun, Iowa State University, who provided the input and guidance for integration of environmental issues and sustainable agriculture concepts in the text. Their help is gratefully acknowledged.

Special thanks are extended to Marilyn Clem, Larry Barr, Karen Kuenzel for the preparation of illustrations retained from prior editions and to Shari Vogl, illustrator for the new edition. Gratitude is also extended to the Iowa State University Seed Science Center and the United States Department of Agriculture for permitting and providing illustrations of seeds and plants. The typist for this edition was Evelyn Kruse, whose patience and assistance were gratefully appreciated. The author wishes to thank Burgess International Group, Inc. for their assistance and support in the preparation of this manuscript.

I would like to affectionately acknowledge the support and understanding of my wife, Michele, and family, whose help and patience made this endeavor possible.

Preface

Crop Science—Principles and Practice (2nd edition) is a spiral bound, “working textbook”. It is the result of continued efforts to provide students with textual material that emphasizes fundamental concepts underlying crop science and production. The first edition entitled, *Agronomy—Principles and Practice*, evolved from the introductory course in crop production at Iowa State University. The second edition continues that evolution.

The new edition, in addition to updating and revision of chapters, also represents efforts to integrate concepts of sustainable agriculture and environmental awareness throughout written materials. It is designed to embrace concerns and questions related to agriculture, environment, and protection of our natural resources rather than ignore them. The text purposefully emphasizes basic principles illustrated with crop examples. It was not designed to be a large reference manual of crop statistics and information lest students lose sight of the principles in a sea of information. The text allows the instructor to enhance the student’s understanding and application of material to different agricultural regions using lecture, discussion, or other instructional formats.

Crop Science—Principles and Practice (2nd edition) was written with the following goals:

- 1) To help students develop the fundamental vocabulary used in crop-, soil-, and climate-related sciences and industries.
- 2) To emphasize the basic principles and relationships among crops and their environment and production.
- 3) To help students learn and apply the broad sciences of botany, anatomy, taxonomy, physiology, soil, climatology, genetics, entomology, and pathology, that are intrinsically involved in crop production.
- 4) To develop a textbook that is flexible for student learning and instructor use. The text is written in outline form to help students identify, follow, and learn concepts. The text was designed and written for students with or without an agricultural background. The text can be used alone, as a lecture supplement, for individualized study, or for remedial learning of basic crop science principles.

Chapter Videos Available:

Through the financial support of the Leopard Center for Sustainable Agriculture, Media Resources Center, College of Agriculture, and Department of Agronomy at Iowa State University, video tutorial tapes were developed for each chapter in the textbook. The videos were instructionally designed and professionally produced to help students learn and visualize textual material and to increase their awareness of the environmental issues and sustainable concepts in agriculture. Videos are 25-60 minutes in length and can be obtained from the Media Resources Center, Iowa State University, Ames, IA 50011-1010.

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For more detailed reference use the Topical Index on the following pages.

Chapter 1

Crop Plant Anatomy

WHY STUDY ANATOMY?

A knowledge of crop plant anatomy is basic to the agronomist for describing and identifying different species and types of plants. Crop anatomy is essential in communication among farmers, entomologists, pathologists, weed scientists, or anyone involved in crop production. Farmers in seed, grain, fiber, or forage production frequently use plant anatomy to distinguish crop pests, to identify optimum management practices and to aid in production decisions. Determining when to replant, optimum hay cutting schedules, and trouble shooting nitrogen deficiency in legumes are just a few examples of where a knowledge of crop anatomy can play an important role in making the right decision.

In this chapter and others, comparisons are frequently made between cereals and legumes. Agricultural crops are frequently subdivided into two broad categories. Monocotyledonous plants (commonly referred to as “monocots” or “grasses”) are those that contain one seed leaf (one cotyledon). Cereal crops are grass crops grown for their seed. Dicotyledonous plants (commonly referred to as “dicots” or broadleaf plants) are those that contain two seed leaves (two cotyledons). An important group within dicots are legumes (podded crops that have nitrogen fixation ability in the root system) and can be grown for their seed (pulse crops/grain legumes) or forage (forage legumes). The various crop classifications are discussed in more detail in Chapter 2.

I. THE PLANT CELL

This unit will begin with a review of the plant cell. The cell is the basis for plant life and much of the research in increasing quality and quantity of crop products for the future is involved at the cellular level. Use the following diagram of a plant cell (Figure 1) and the information to help you understand the functions and characteristics of the parts:

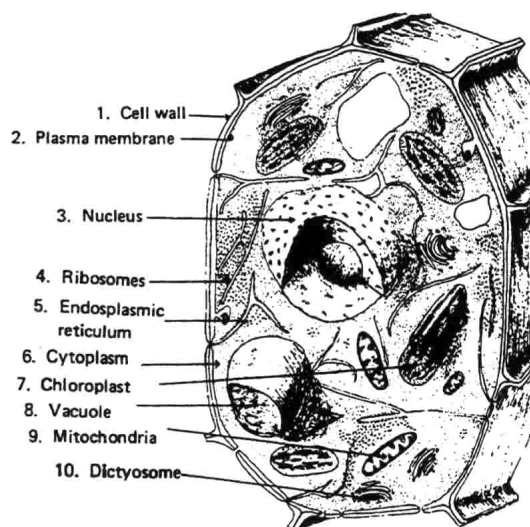


Figure 1. General features of a young plant cell

After studying the diagram, you should be able to properly label the cell components, give their function and to describe their importance.

<u>Cell Part</u>	<u>Function or Characteristic</u>
1. Cell Wall	Protects the inner parts of the cell and gives rigidity to the cell. Hay quality is influenced by cell wall digestibility.
2. Plasma membrane	Differentially permeable-some materials will pass through this membrane while others will not. Some herbicides kill weeds by breaking down membrane structure.
3. Nucleus	Contains chromosomes which contain the genetic material (DNA) involved in the inheritance of characteristics.
4. Ribosomes	Involved in protein manufacture in the plant.
5. Endoplasmic reticulum	Involved in protein manufacture in the plant.
6. Cytoplasm	Living gel-like material containing the functioning parts of the cell. Cold hardiness in crops is influenced by changes in cell cytoplasm.
7. Chloroplast	A principal type of plastid containing chlorophyll-the site of photosynthesis in the plant cell.
8. Vacuole	A storage region for desirable and undesirable cellular materials. Also acts as an internal balloon to help regulate water pressure within the cell and to maintain proper cell rigidity. Size varies with age of the cell.
9. Mitochondria	Site of aerobic respiration that is the main source of energy for cellular metabolism and growth.
10. Dictyosome	Associated with cell wall formation. (Golgi apparatus)

Plant or Animal Cell?? Based on plant cell characteristics, what cell parts are not found in animal cells? (Hint: animal cells are not rigid, nor do they photosynthesize.)

II. SEED AND SEEDLING ANATOMY

Seeds are miniature plants in an arrested state. Research has shown that seeds can be damaged by rough handling and improper storage. Some seed parts are more vulnerable to damage than others. A knowledge of seeds and seedling parts is important in judging the quality of seeds, estimating seeding vigor and predicting germination and establishment success. In this section cereal crops (i.e. maize, wheat, rice, etc.) are compared with legume crops (soybeans, peanuts, alfalfa, etc.).

From the following information you should be able to label and describe functions of the parts of:

- A. Cereal seed and seedlings
B. Legume seed and seedlings

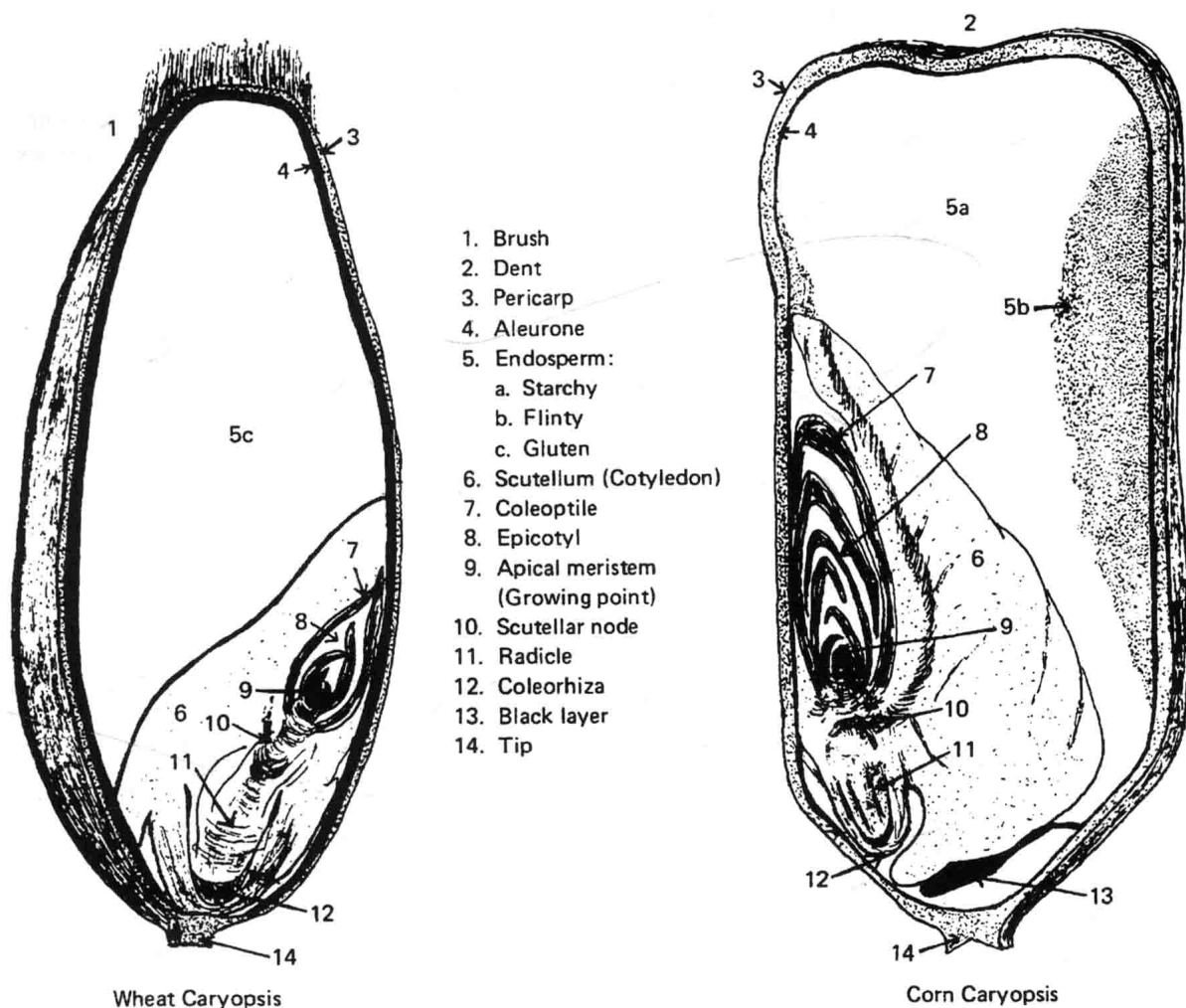


Figure 2

A. Cereal Caryopsis Anatomy

<u>Kernel Part</u>	<u>Function or Characteristic</u>
1. Brush	Tuft of persistent hairs on tips of wheat kernels.
2. Dent	Found on tops of corn (maize) kernels (in dent corn). Forms because soft starch in the center of the kernel shrinks more on drying than does the flinty endosperm along the outside of the kernel.
3. Pericarp	Primarily ovary tissue (maternal tissue) which protects the caryopsis (kernel). The caryopsis is a ripened ovary (fruit) because of the presence of the pericarp and therefore, is not a true seed (ripened ovule). Red color in some corn seed is found in the pericarp. Pericarp characteristics are determined by the mother plant.