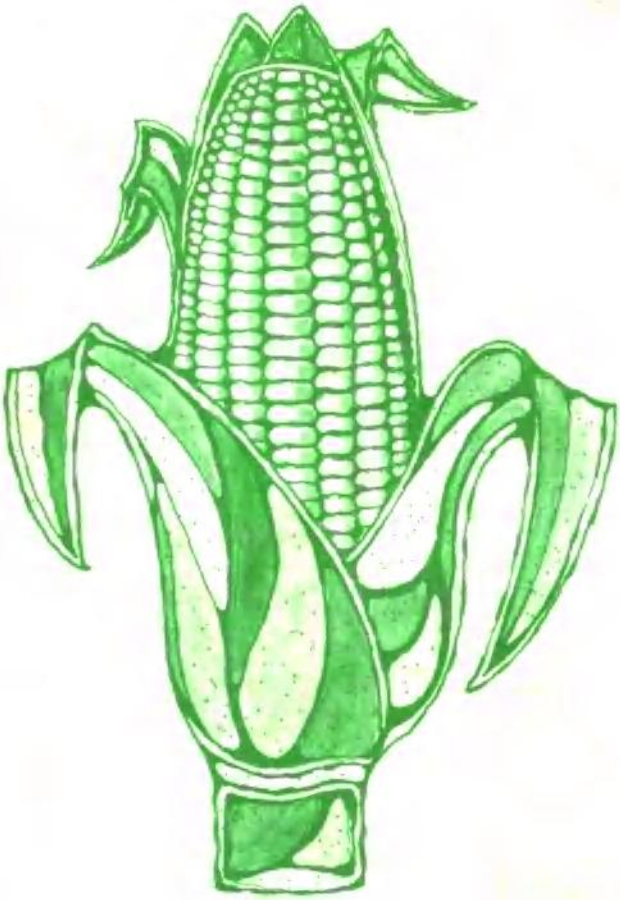
CORN

IMPROVEMENT, SEED PRODUCTION, AND USES



Robert W. Jugenheimer

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PREFACE

This is a completely rewritten and expanded revision of the book entitled *Hybrid Maize Breeding and Seed Production* published in 1958 by the Food and Agriculture Organization of the United Nations, Rome, and available in English, French, Spanish, and Polish editions. Current editions have been used in at least 86 countries throughout the world.

The original book evolved from a course in the breeding and genetics of corn taught by the author at the University of Illinois to advanced undergraduates, graduate students, and professional workers from many countries. The revised book should be of value to scientists, students, seedsmen, corn producers, industry, and the general public.

Corn is the most important plant native to America. The United States produces about 44 percent of the world crop; however, the corn crop is international in importance and hybrid corn has revolutionized world agriculture. This crop usually is grown on more than 100 million hectares each year, with a production of about 250 million metric tons. More is known about the genetics of corn than of any other economic plant or animal, and the plant is especially well suited for genetic research and improvement.

Corn has hundreds of uses. It is used primarily as a food for humans in some areas of the world, in contrast to the United States where about 85 percent of the crop is fed to livestock. Corn provides the United States with more food than any other cereal crop. It also yields more industrial products than any other grain; four industrial users include mixed feed manufacturers, dry process millers, wet processors, and distilling and fermentation industries.

The origin of corn is lost in antiquity. Archaeological and geological excavations and measures of radioactive decay of old ears of corn found in caves indicate that the plant must have originated at least 5000 years ago. The place of origin probably was Mexico, Central America, or the southwestern United States. Mutation, natural selection, and mass selection by the American Indian gradually transformed wild corn into a plant worthy of domestication.

Corn improvement in the United States evolved from simple mass selection used by the Indians and early white settlers to the application of genetic principles and utilization of "heterosis." The importance and employment of heterosis depend on increased yields, the acquisition of other desired agronomic characters, ease of hybridization, and a low cost of seed production. The corn plant meets these qualifications in an unusual manner to produce hybrids among inbred lines.

Breeding systems involve line development, line improvement, population improvement, and cross improvement. Modern corn breeders must recognize the importance of germ plasm for both immediate and future use. The development and intelligent evaluation of inbred lines is a laborious and complex procedure.

Corn researchers must incorporate many desirable characteristics into modern hybrids. Very important traits include high yields, proper maturity, and excellent standability. Fortunately corn is extremely variable and, consequently, workers are able to obtain plants and ears suitable for special purposes and uses, including food for humans, feed for animals, and materials for industry. Sweet corn is a popular green vegetable; popcorn is used for popping and confections; waxy corn provides specialty products. Special effort is being devoted to more and better quality protein for improved nutrition; oil for industry and high energy feed; as well as amylose for plastics, cellophanes, films and other products.

Development and evaluation of hybrids or composites are continuing and complex objectives. Several kinds of hybrids are possible, depending on the number and arrangement of parental inbred lines. Performance trials require the use of modern experimental designs, statistical methods, and electronic equipment.

Desirable production practices must go hand in hand with adapted corn hybrids. Food for plants is just as necessary as food for humans and animals. Desirable hybrids can achieve their fullest potential only when they are grown on soils well supplied with balanced amounts of plant food. Resistance and tolerance to heavy plant populations, cold, heat, drought, insects, and diseases must be bred into hybrids.

Use of hybrid corn has resulted in the development of a new enterprise: the production, processing, sale and distribution of hybrid seed. Production of these businesses varies from a few hundred bushels of seed to many thousands of bushels (quintals) per year. Millions of dollars are invested in land, personnel, plants, and equipment to produce, process, sell, and distribute this seed. Chapters in this book have been devoted to training seed technologists; production of seed; planning an efficient processing plant; harvesting, processing, and storage of seed; marketing; foundation seed stock organizations and seed certification; and policies and legislation.

I greatly appreciate the assistance provided by Mrs. Janice T. Small of the Agronomy Department of the University of Illinois. Grateful thanks are expressed to my wife, Mabel H. Jugenheimer, for encouragement, and to Mrs. L. Elaine Apple for her fine secretarial assistance.

English, French, and Spanish editions of the original book were published by the Food and Agriculture Organization of the United Nations. Special acknowledgment is due the FAO of U.N. for use of material from the first editions. The Polish edition was published by Dr. Jan Bojanowski in Warsaw in 1964.

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I accept the final responsibility for the manuscript.

ROBERT W. JUGENHEIMER

Urbana-Champaign, Illinois
July 1975

CONVERSION FACTORS FOR ENGLISH AND METRIC UNITS

To convert column 1 into column 2, multiply by	Column 1	Column 2	To convert column 2 into column 1, multiply by
		Length	
0.621	kilometer, km	mile, mi	1.609
1.094	meter, m	yard, yd	0.914
0.394	centimeter, cm	inch, in	2.540
		Area	
0.386	kilometer^2, km^2	mile^2, mi^2	2.590
247.1	kilometer^2, km^2	acre, acre	0.00405
2.471	hectare, ha	acre, acre	0.405
		Volume	
0.00973	meter^3, m^3	acre-inch	102.8
3.532	hectoliter, hl	cubic foot, ft^3	0.2832
2.838	hectoliter, hl	bushel, bu	0.352
0.0284	liter	bushel, bu	35.24
1.057	liter	quart (liquid), qt	0.946
		Mass	
1.102	ton (metric)	ton (English)	0.9072
220.5	quintal, q	pound, lb	0.00454
2.205	kilogram, kg	pound, lb	0.454
0.0353	gram, g	ounce (avdp), oz	28.35
		Yield or Rate	
0.446	ton (metric)/hectare	ton (English)/acre	2.242
0.892	kg/ha	lb/acre	1.12
0.892	quintal/hectare	hundredweight/acre	1.12
		Pressure	
14.22	kg/cm^2	lb/inch^2, psi	0.0703
0.968	kg/cm^2	atmospheres, atm	1.033
0.9807	kg/cm^2	bar	1.0197
		Temperature	
$\frac{9}{5}$C + 32	Celsius, C	Fahrenheit, F	$\frac{5}{9}$(F−32)
	−17.8°	0°	
	0°	32°	
	20°	68°	
	100°	212°	

American Society of Agronomy

CONTENTS

PART I

CORN IS ESPECIALLY WELL-SUITED FOR RESEARCH AND DEVELOPMENT