Heritage Corn: Origins, Types, Traits

Margaret E. Smith

Plant Breeding
and Genetics

AIISP Land Acknowledgment

Cornell University's Ithaca campus is located on the traditional homelands of the Gayogo̱hó꞉nǫ' (the Cayuga Nation), a member of the Haudenosaunee Confederacy which is an alliance of six sovereign Nations with a historic and contemporary presence on this land. The Confederacy precedes the establishment of Cornell University, New York State, and the United States of America. We acknowledge the painful history of Gayogo̱hó꞉nǫ' dispossession, and honor the ongoing connection of Gayogo̱hó꞉nǫ' people, past and present, to these lands and waters.

Topics

- Where did corn come from?
- How were heritage varieties developed?
- What do we know about heritage corn and its performance ?

Where did corn come from?

- Domesticated in MesoAmerica
- Ancestor: teosinte
- Selection for:
  - more kernel rows
  - no hard seed coat
  - non-shattering

What farmer breeders achieved:

- Higher yields

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- Broad adaptation
  - Altitude
  - Latitude
  - Climates

What farmer breeders achieved:

- Higher yields
- Broad adaptation
  - Altitude
  - Latitude
  - Climates
- Many uses
  - Colors
  - Grain types
  - Flavors

Who Domesticated Who??

- Corn cannot survive in nature
  - Defense?
  - Dispersal?
- Can you?

Co-evolution: corn has evolved quite elaborately to take excellent advantage of dispersal by… us!

Corn - Human Co-Evolution

- Seed saving
- Land preparation
- Weed control
- Protection from insects and diseases
- Scaring off birds, mammals, etc.

Northeastern Heritage Corns

- Predominantly flint types
  - Long ears
  - 8-10 kernel rows
  - Thick cob
  - Early maturing
  - Tend to tiller

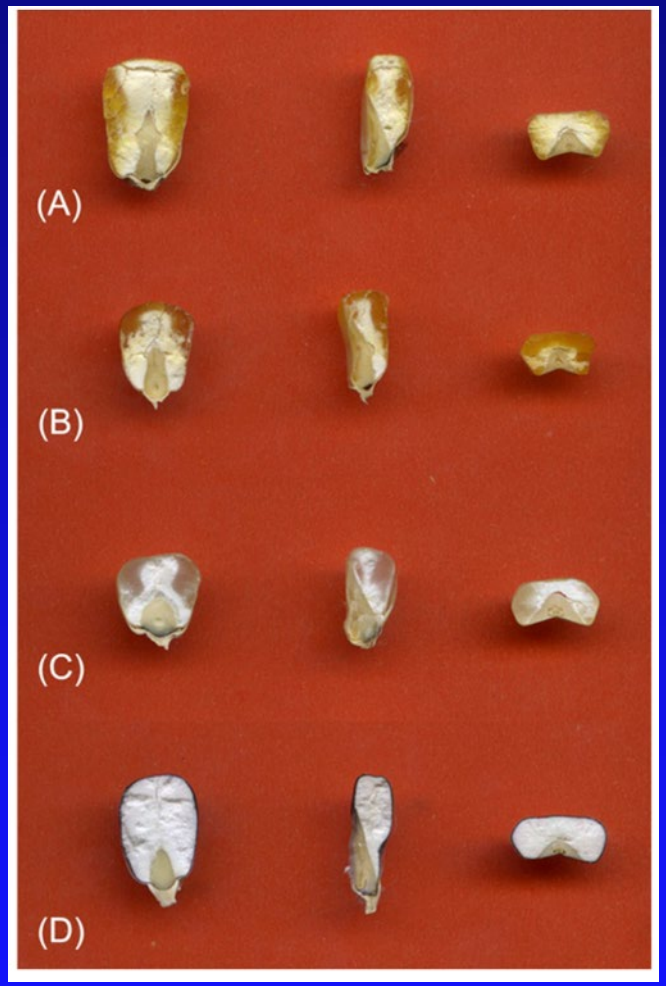


FIG. 6.2 Distribution of vitreous and floury endosperm in different types of corn kernels: A, dent corn; B, flint corn; C, quality protein maize; D, flour corn. Left column, longitudinal section parallel to germ front; center column, perpendicular section to the germ front: right column, cross section through median line of kernel (×2). *(Courtesy of MSc. Veronica Rocha-Villarreal.)*

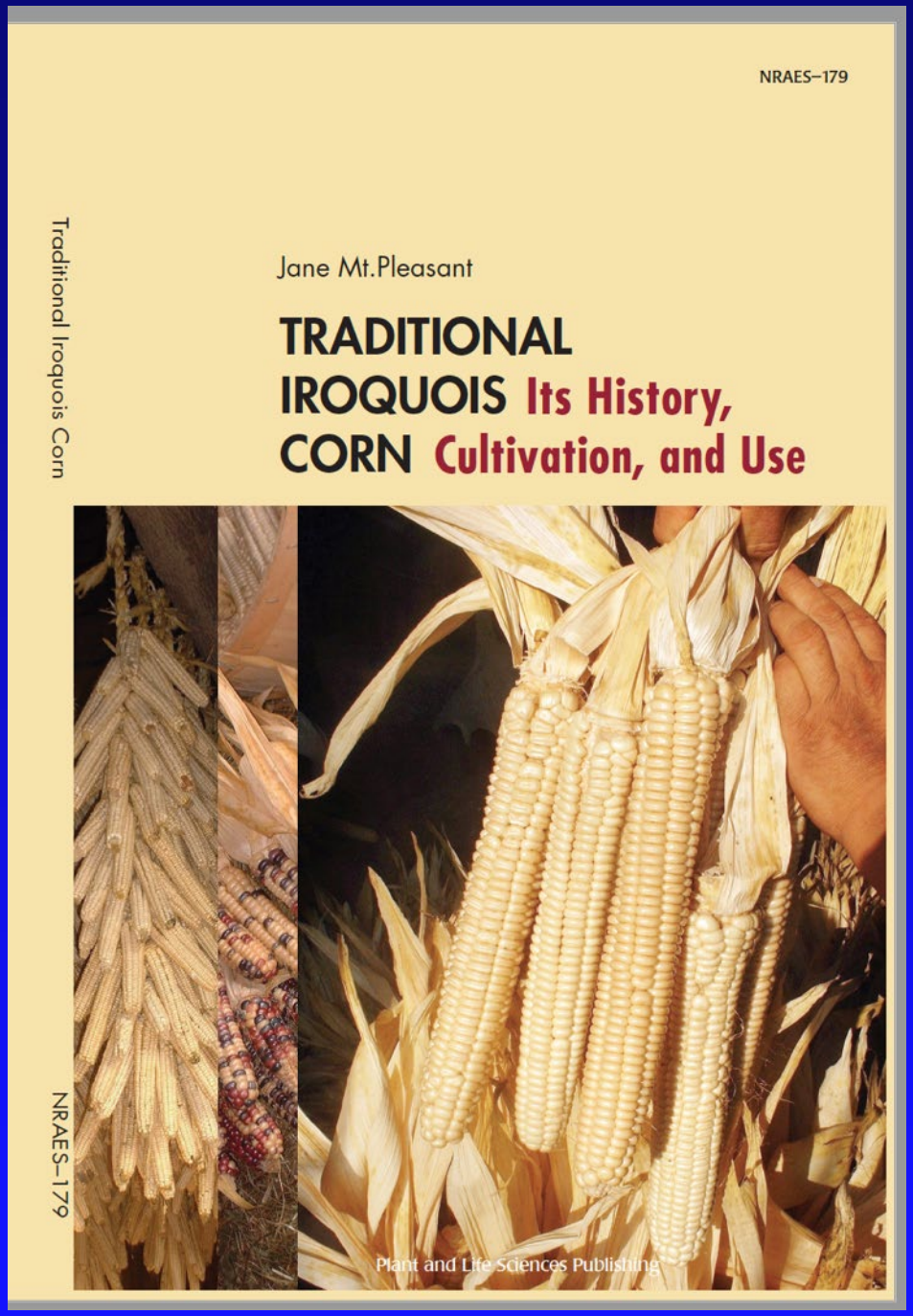

NRAES–179
Traditional Iroquois Corn
Jane Mt.Pleasant
TRADITIONAL IROQUOIS CORN Its History, Cultivation, and Use
NRAES–179
Plant and Life Sciences Publishing

TABLE I
VARIETIES FROM THE NORTHEAST

Variety	Source	Cob color	Kernel color	Kernel thickness (cm.)	Kernel width (cm.)	Dent-ing*	Diam. shank (cm.)	Number of rows	Number of chromosome knobs**
Canada Flint	Feeding Hills, Mass.	White	Yellow, purple	.46	1.0	0	1.4	8	0
Dutton	Newark Valley, N. Y.	White	Yellow, purple	.40	1.0	0	2.1	8	2
Harris Mammoth Yellow	Rochester, N. Y.	White	Yellow	.44	1.1	0	1.6	8	0
Longfellow	Ontario	White	Yellow	.41	1.0	0	1.5	8	1
Mammoth Yellow	Ithaca, N. Y.	White	Yellow	.38	1.0	0–1	1.6	8	2
Parker's Flint	Potsdam, N. Y.	White	Purple, red, yellow	.44	1.0	0	1.1	8	0
Quebec Flint	Restigouche, Que.	White	Yellow	.20	.5	0	.8	8–10	1
Smut Nose	Bath, N. Y.	White	Yellow, red	.48	1.0	0	1.7	8	2
Stevens	Ithaca, N. Y.	White	Yellow, red	.41	1.1	0	2.4	8	0
Thayer Flint	Searsport, Me.	White	Yellow	.44	1.0	0	1.9	8	0
Thompson Flint	East Andover, N. H.	White	Yellow, red	.45	1.0	0	1.4	8	0
12-row Red Flint	Dryden, N. Y.	White	Yellow, red	.40	.9	0	2.1	12	1
12-row Yellow Flint	Dryden, N. Y.	White	Yellow, red	.44	.8	0	1.6	12	0
Wilbur's Flint	Hudson Falls, N. Y.	White	Yellow	.50	1.0	0	1.4	8	0

* 0—no denting or visible soft starch; 1—visible soft starch; 2—slight dent.

** Numbers do not include organizer knob on chromosome 6.

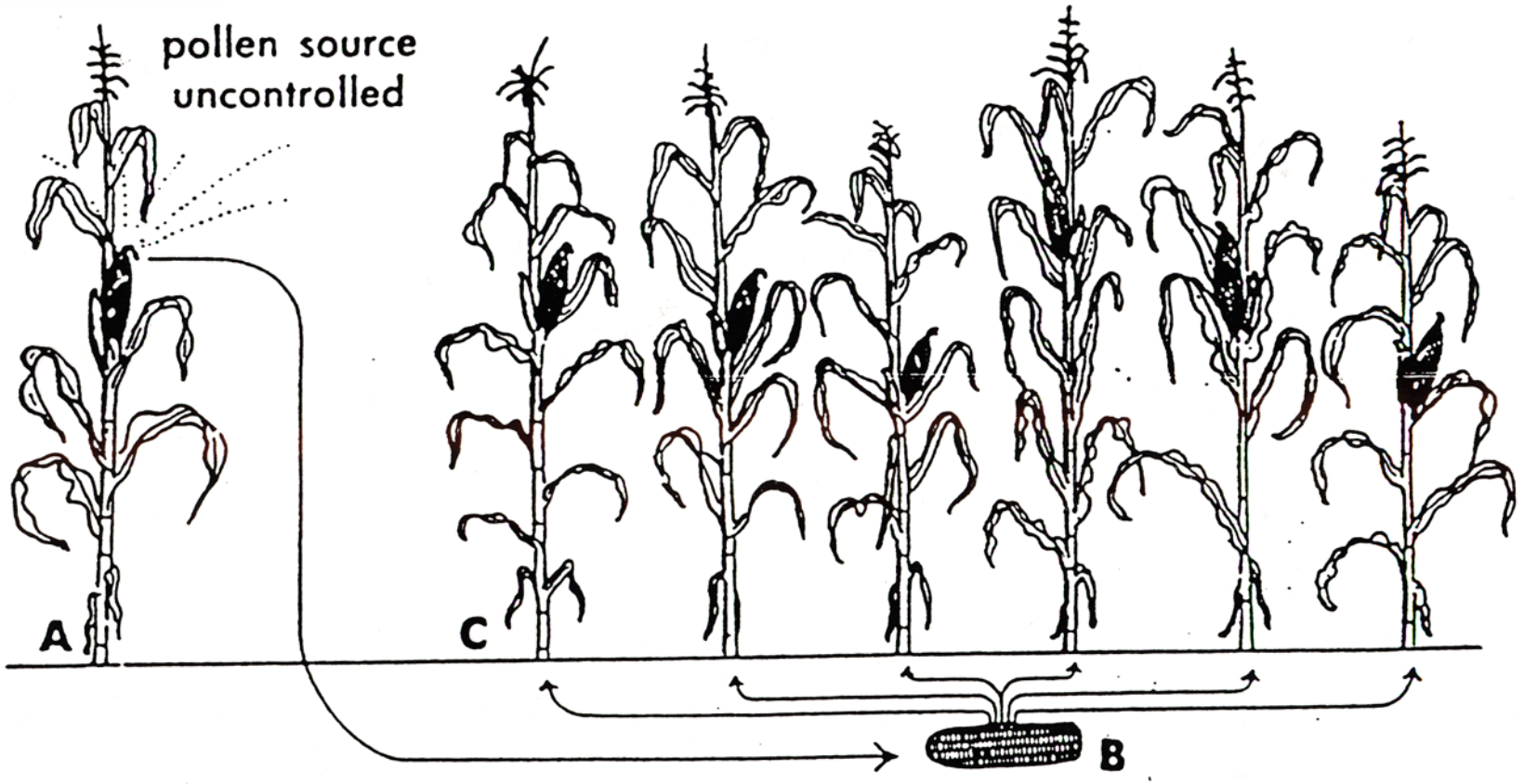
From collections made in 1944-1946
(Brown and Anderson, The Northern Flint Corns, 1947)

Reid's Yellow Dent

Fig. 4b: Northern Flint (Longfellow, top) and Southern Dent (Gourdseed, bottom) ears *(University of Nebraska-Lincoln, 2004)*

Open-Pollinated Varieties, Hybrids – what's the difference?

What is an "open-pollinated variety"?



About OP Varieties…

- Every plant is a different hybrid
- Seed can be saved
- Choosing which seed to save will change the variety

What is a “hybrid”?

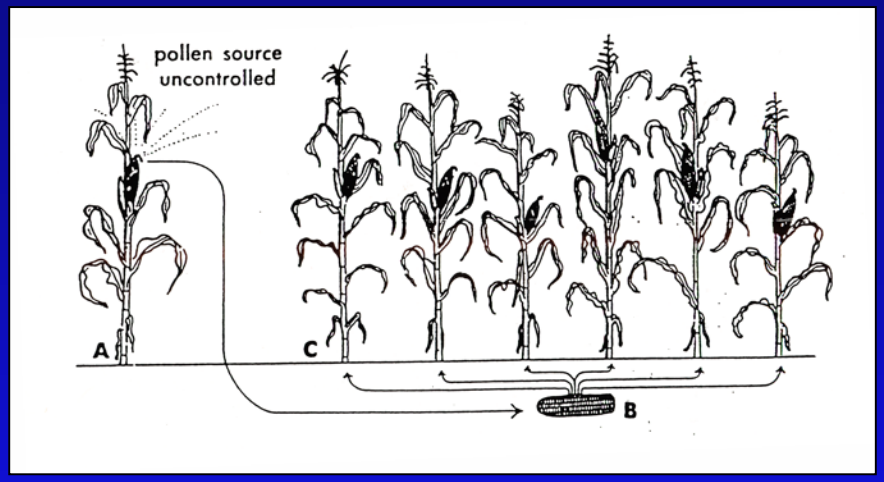
- The plants grown from seed of a cross between two different parents
- Often has better vigor (size, maturity, yield) than the parents

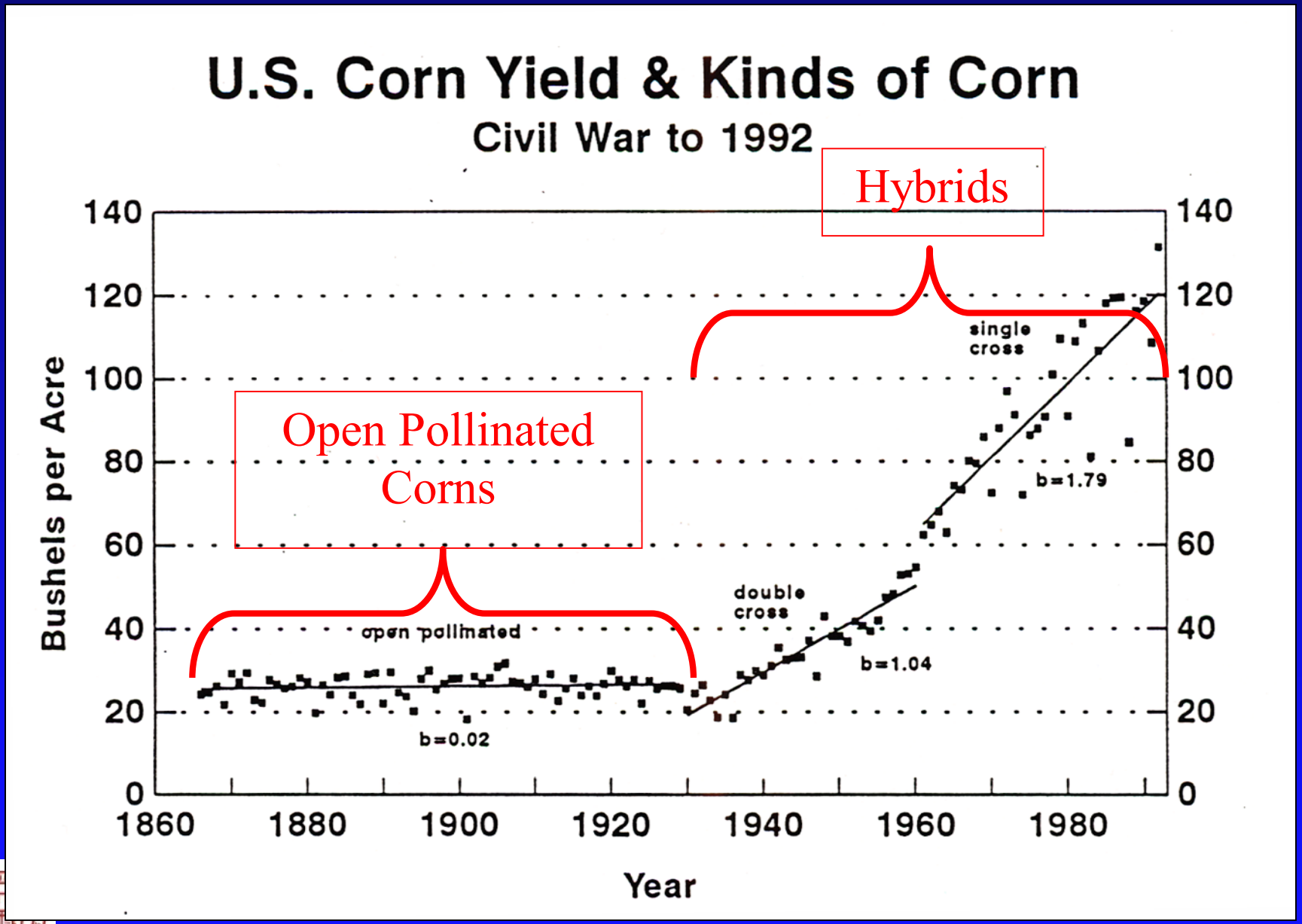
How do breeders make hybrids?

- Pollinate plants with themselves until they are true breeding
  - Called inbreds
- Make crosses between inbreds → hybrid seed
- Evaluate these hybrids to pick the best

About single cross hybrids…

- Every plant is genetically the same as every other
- Seed saved from a hybrid will have varied and inferior performance



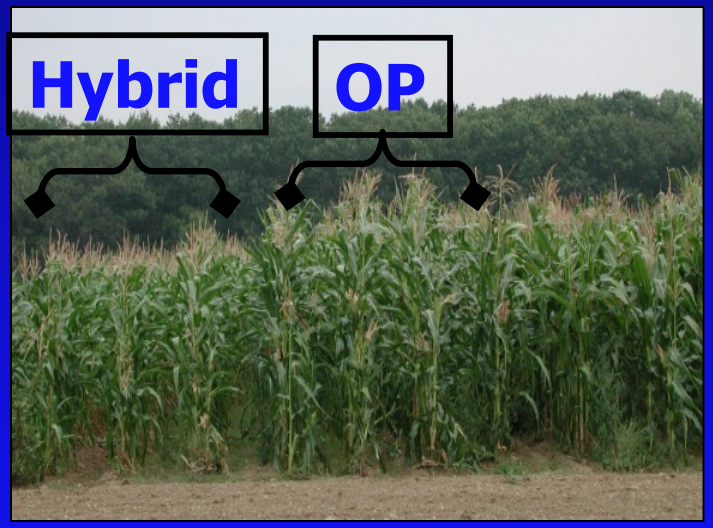

U.S. Corn Yield & Kinds of Corn
Civil War to 1992
Hybrids
Open Pollinated Corns
Bushels per Acre
Year
open pollinated
b=0.02
double cross
b=1.04
single cross
b=1.79
0
20
40
60
80
100
120
140
1860
1880
1900
1920
1940
1960
1980

Open pollinated corn evaluation

- Reasons for considering OPs:
  - Control of seed production
  - Unique traits
  - Option to select your own version
  - Seed cost vs. returns
- Little data on performance
- "Same" variety can differ depending on seed source

Northeast SARE OP corn project

- Strip trials of most promising OPs
  - Grain yield and quality
  - Silage yield and quality
- Small plot trials (1/500 A) of many OPs
  - Grain yield and moisture
  - Plant type



Results to present today: small plot trials only

- Total of 68 open-pollinated corns evaluated
  - 45 heritage varieties
  - 23 more recently developed/improved varieties
- The six "most promising" OPs in the strip trials did not include any heritage varieties

Small Plot Evaluations: Late Maturing Varieties, 3 Years

Variety	Yield, bu/A	Grain Moisture, %	Yield: Moisture Ratio	Lodging, % Stalk	Lodging, % Root
Beasley's Red - low	50	27.5	1.8	60	24
Pioneer 34B23	**177**	**28.4**	**6.2**	**17**	**3**
BD - low	77	28.5	2.7	37	7
FS Seeds 6001	**171**	**29.4**	**5.8**	**17**	**6**
Greenfield 114 - low	92	30.0	3.1	37	14
BSSS(R)C15 / BSCB1(R)C15	123	30.1	4.1	34	6
Reid - low	93	30.7	3.0	44	16
BS11(S2)C5 - high	112	30.8	3.6	42	1
Buck Lantz - low	61	31.8	1.9	51	13
Trucker's Yellow - low	83	31.9	2.6	62	10
BS31(R)C1 - high	99	32.0	3.1	27	4
C.V., %	22.3	6.8			
ANOVA	**	**		**	**

Small Plot Evaluations: Late Maturing Varieties, 3 Years

		Grain	Yield:		
	Yield,	Moisture,	Moisture	Lodging, %	
Variety	bu/A	%	Ratio	Stalk	Root
Beasley's Red - low	50	27.5	1.8	60	24
Pioneer 34B23	**177**	**28.4**	**6.2**	**17**	**3**
BD - low	77	28.5	2.7	37	7
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Pioneer 38K06	**119**	**27.0**	**4.4**	**19**	**3**
NDSAB	83	27.1	3.1	38	3
Pioneer 38T27	**133**	**27.1**	**4.9**	**21**	**8**
NDSM	76	27.7	2.7	54	7
Early Butler	63	27.8	2.3	51	16
Wisconsin 25	55	27.9	2.0	52	8
Wapsie Valley	79	28.2	2.8	32	8
Wapsie Valley	86	28.6	3.0	37	7
Minnesota 13	69	29.0	2.4	44	8
Wapsie High Density	103	29.0	3.5	41	11
Northwestern Dent	55	29.5	1.9	82	10
Golden Glow	71	29.6	2.4	58	9
Iroquois White	44	29.9	1.5	69	8
E-95	93	30.2	3.1	35	5
Reid	82	30.3	2.7	30	11
BS21(R)C7	90	30.7	2.9	29	3
Reid	83	31.1	2.7	31	11
BS22(R)C7	95	31.2	3.0	32	3
BS21(R)C7 / BS22(R)C7	105	31.2	3.4	23	6
Reid V	83	31.4	2.6	29	11
Nokomis Gold	87	31.5	2.8	30	8

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What did we learn about OPs?

- Heritage OPs do not compete with recently developed OPs in terms of yield, agronomics
- OPs do not compete agronomically with hybrids
- Yield reductions may be offset by inexpensive seed in fields that have lower yield potential
- Silage use more promising than grain use?
- Key asset = specialty grain quality features

What does it take to select and save your own OP seed?

- What ears you pick will determine the genes that continue in your variety
  - Choose carefully!

What does it take to select and save your own OP seed?

- You must save at least 100 ears
  - If not, in time you will see reduced vigor due to inbreeding
- Identify the best plants before harvest
  - Full competition, healthy, standing

What does it take to select and save your own OP seed?

- Choose the best and healthiest ears from those plants

What does it take to select and save your own OP seed?

- Ears must be carefully dried
  - Temperatures higher than 100˚F will kill the seed!
  - Seed moisture low to keep away molds

- Seed must be shelled and cleaned
- Store away from humidity, heat, pests

What does it take to select and save your own OP seed?

- Germination and purity tests would be good to have done…
  - Avoid sowing dead seed!
  - Avoid sowing weed seed!

- Producing clean, healthy, high quality seed is more complicated and much more labor intensive than producing grain…

THE CORNELL READING COURSE FOR THE FARM

"Upon the farmers of this country in large measure rests the fate of the war and of the nations."—PRESIDENT WILSON, April 15, 1917

Under war conditions the skillful work of the man on the land has become more important than ever before. There is indeed every reason for zeal in increasing food production. Knowledge will help to make labor productive. Abraham Lincoln once said, "No other human occupation opens so wide a field for the profitable and agreeable combination of labor with cultivated thought, as agriculture." The College of Agriculture, thru the Reading Course for the Farm, offers twelve series of lessons for home study free to residents of New York State. The attached discussion paper gives details about these series.

The reading course lessons are elementary and brief. Three advanced reading courses, in farm crops, fruit growing, and vegetable gardening, provide more complete instruction in accordance with modern correspondence methods. Each student provides himself with a textbook and materials for practical exercises. Reports are prepared which are corrected, graded, and returned with criticisms and suggestions.

In a number of communities groups have organized for the discussion and study of common problems, and have adopted the name Cornell Study Club. The primary purpose of a Cornell study club is to furnish an occasion and an incentive for discussing reading course lessons for the farm and for the farm home, but the objects include the accomplishment of local improvements, the encouraging of cooperative buying and selling, and the bringing of outside speakers into the community. Cornell study clubs are educational and social centers, and should develop local leadership and the human resources of the community. Assistance is given in organizing and conducting clubs, and speakers are sent to clubs occasionally in connection with the regular extension work of the College.

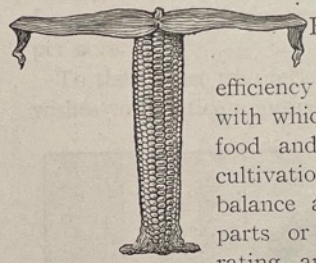
Correspondence is a medium for the exchange of helpful information. Letters will receive careful attention.

ROYAL GILKEY,
Supervisor of the Cornell Reading Course for the Farm.

lesson 129 . Oct 1917

IMPROVING THE CORN CROP BY SELECTION AND BREEDING

FRANK P. BUSSELL[1]



THE corn plant is a factory. Its product is a quantity of grain, stover, or silage. Its efficiency in production depends on, first, the facility with which it obtains from soil and air its supplies of food and water, or in other words, soil fertility, cultivation, and climatic conditions; second, the proper balance and fine adjustment between the working parts or organs of the plant in receiving, elaborating, and storing as grain or stalk the raw materials received thruout the growing season. Inherited constitutional vigor, freedom from disease, and ability to concentrate all its energies on producing corn, make for efficiency of production. Economy in expenditure of effort is the meaning of efficiency; and viewing the corn plant as a corn producer, it is important that efficient individuals be chosen, just as it is important that high-producing dairy cows or labor-saving machinery be used.

WHAT IS A FIELD OF CORN?

The evidence for the view that an ordinary cornfield consists of more or less related individual plants, each differing from the other in its hereditary make-up, is not new; yet only in recent years has it been given practical consideration in seed selection. The whole field constitutes a mixture, a lot of individuals each varying from its neighbor in plant, ear, or kernel characters and, what is more important, in the hidden characters already enumerated, which, taken together, result in high or low yield, in efficiency or lack of efficiency.

Are there any marks on the corn plant, the ear, or the kernel that indicate whether the seeds will produce efficient plants the next season? For example, will the fine-appearing seed ear prove a better yielder than the less fancy one, provided both are equally sound? Will a thick stalk produce more corn than a thinner one of the same variety, a broad-leaved plant more than a narrow-leaved one, or a tall plant more than a shorter one?

[1] Other members of the staff of the Department of Plant Breeding gave helpful suggestions in the preparation of this lesson, and Professor C. H. Myers and W. I. Fisher assisted in preparing the illustrations.

Open-Pollinated Corn Varieties

A Descriptive Catalog

Margaret E. Smith,
Jane Mt. Pleasant, and Stefan Seiter
2007