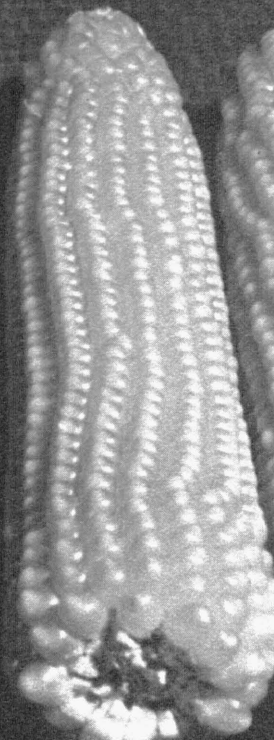
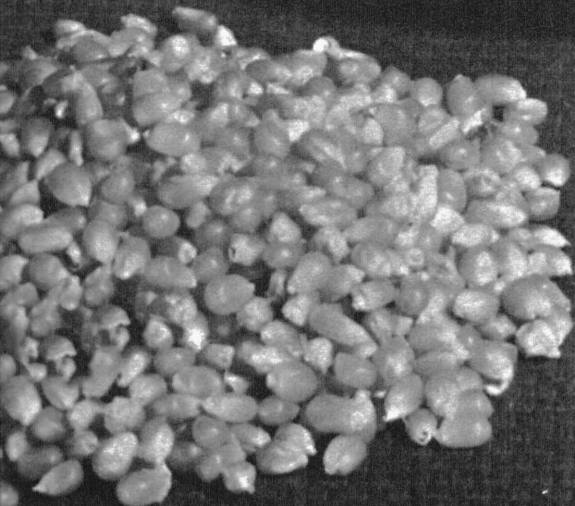
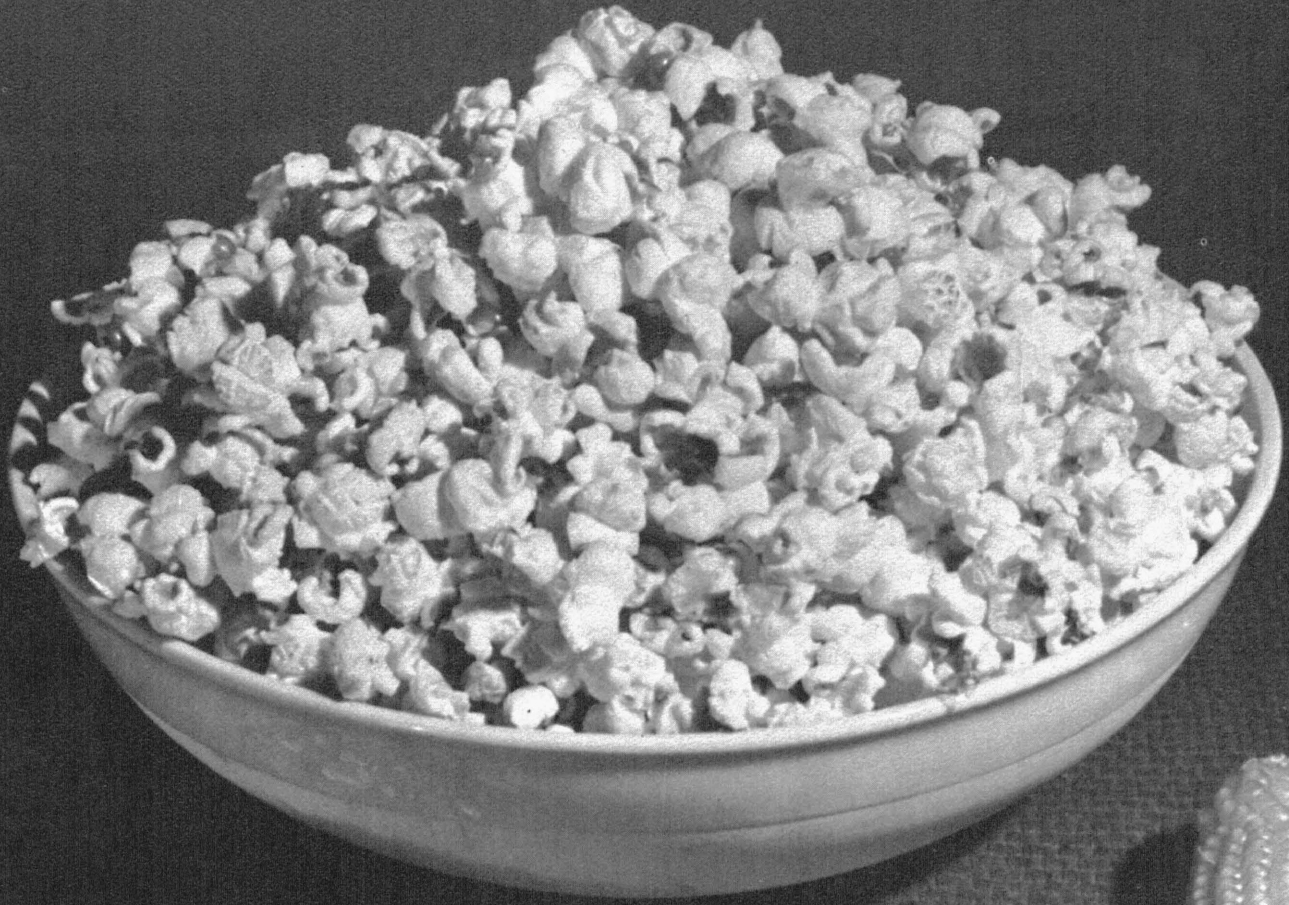


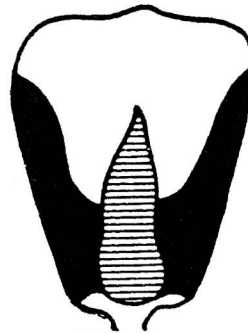
POPCORN CULTURE

in Missouri





POP CORN



DENT



Horny Starch



Soft Starch

When corn is heated, the moisture in the grain expands into steam. In popcorn, the horny starch coating contains this steam until pressure is built up; then it explodes. In contrast, when dent corn is heated, the steam escapes easily and gradually through the soft starch which covers a big portion of the kernel.

POPCORN CULTURE

in Missouri

C. O. GROGAN, O. V. SINGLETON, AND M. S. ZUBER

Popcorn production in Missouri fluctuates with the crop's market value and the acreage allotments of other crops. During World War II, popcorn was widely accepted as a substitute for candies and sweets, then so scarce because of the sugar shortage. The development of the electric popper and the availability of electricity in more farm homes have given an added stimulus to the use of popcorn. Although home use of popcorn is important, the largest quantity of popcorn is used by concessions at parks, theaters, and other amusement centers.

Economic Value of Popcorn

The annual acreage of popcorn in Missouri ranges from 8,000 to more than 15,000 acres with a 10-year average (1948-1957) of 12,000 acres. The average yield during this period was 1650 pounds per acre with an average price of \$3.50 per hundred pounds, ranging from \$5.40 in 1948 to \$2.15 in 1957. The Missouri acreage in 1957 was about 15 percent below that of the previous year, and with a lower yield per acre, total production was down 25% from 1956. The acreage, however, was about equal to the

1948-1957 average.

Popcorn production is concentrated mainly in 12 states: Ohio, Indiana, Illinois, Michigan, Iowa, Missouri, Nebraska, Kansas, Kentucky, Oklahoma, Texas, and California.

Missouri ranked sixth in acres of popcorn and fifth in acre yield in 1956 and 1957. The largest popcorn acreage is located in the northwest section, but production is scattered throughout the state.

Why Popcorn Pops

All starchy corn may be classified in one of four categories on the basis of distribution and proportions of horny and soft starch in the

Acknowledgments

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endosperm: popcorn, flint corn, dent corn, and flour corn. The endosperm of the best strains of popcorn is horny throughout, containing only a small core of soft starch near the center.

Popping properties of the different kinds of corn follow rather closely the relative amounts of hard, or horny starch in the endosperm. Popcorn with a high proportion of hard starch is best in "popability."

The popping process is due to the sudden liberation of steam by pressure after the vapor has generated within the kernel. The colloidal matrix in which the starch grains are embedded within the cell confines this steam until the pressure is strong enough to cause the grain suddenly to burst. Dent corn kernels do not

have the ability to contain the steam until the kernels explode.

Popcorn's quality depends upon its flavor and tenderness. A large expansion during popping is closely associated with tenderness. It also means a large volume of the finished product from a given quantity of popcorn.

Popping expansion depends upon three major conditions: (1) inherent structure of the kernels, (2) kernel moisture, and (3) proper application of heat. Good expansion during popping may be expected from popcorn containing 12 to 15 percent moisture, the best moisture content being 13.5 percent. The volume expansion decreases rapidly for samples having less than 11 or more than 16 percent.

Types of Popcorn

Popcorn varieties can be divided into five groups: White Rice, Queen Golden, South American, Jap Hulless, Tom Thumb. (See Pictures.) Many different varieties and selections exist which can be classified under these five groups.

Recommended Hybrids

Commercial popcorn hybrids fall into two main groups based on physical appearance: rice types with sharply pointed kernels, and the pearl types with smooth, rounded kernels.

White Rice and Jap Hulless types are included in the rice group. White Rice has an ear approximately 7 inches long with 16 to 20 rows, while the Jap Hulless types have similar ears, about 3 to 4 inches long with 30 to 40 rows. The Jap Hulless types are noted for their excellent quality and tenderness. Both the

THE FIVE GROUPS OF POPCORN*

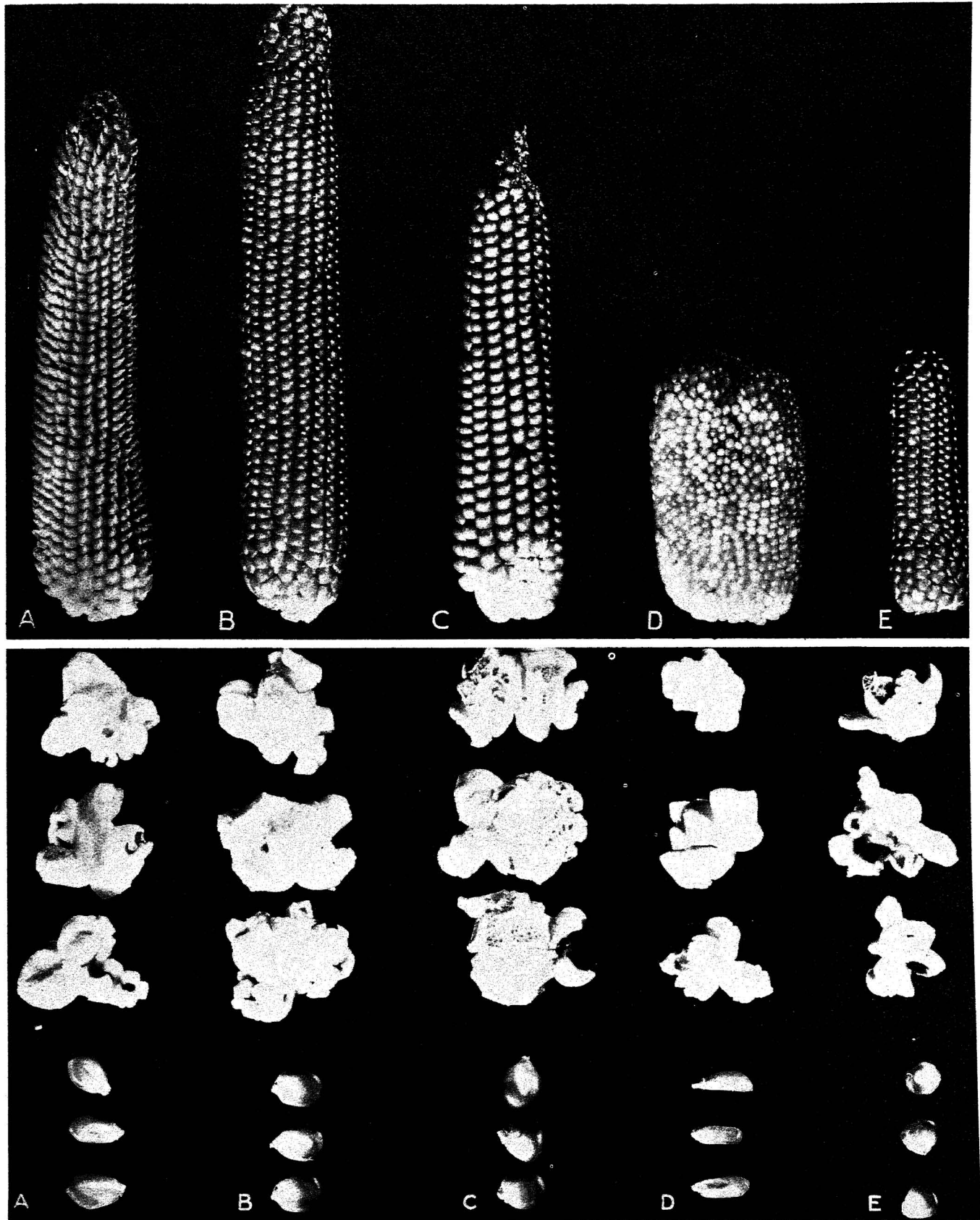
A—White Rice

B—Queen Golden

C—South American

D—Jap Hulless

E—Tom Thumb



*This is a classification established recently by Arthur M. Brunson and Dewayne L. Richardson in USDA Farmer's Bulletin No. 1679, Popcorn, April, 1958.

White Rice and the Jap Hulless are popular for small gardens and home production.

The pearl types are increasing in popularity among the large commercial users of popcorn. These types are desirable for the commercial trade since they give a higher yield per acre and a larger volume of expansion than the rice types. Pearl hybrids have a popping expansion of 25 to 34 units, compared with 22 to 30 units for rice hybrids.

Table 1 gives the pedigree, color, type, maturity and lodging for the open-pedigree hybrids recommended by the Missouri Agricultural Experiment Station. All yield well and have high or medium popping expansion.

One of the more popular popcorns in Missouri is *Purdue 32*, or *Kansas K4*, a hybrid from the Supergold and South American varieties. *Purdue 32* produces a popped corn of excellent quality and has a popping expansion of 28 to 35 units. (See picture of specimen ears of this hybrid.)

The hybrids *Purdue 31*, *Iopop 6*, and *Iopop 8* are very good yielders, ranking above *Purdue 32*, but they are somewhat lower in popping expansion.

Purdue 202 is an earlier hybrid than *Purdue 32*, but will not compete in yield with most of the later maturing types. However, it

compares favorably in popping expansion. Among the late hybrids, *Purdue 406* gives an excellent yield.

One of the leading white hybrids is *Purdue 303*. Several experimental hybrids that exceed *P303* promise an early development of improved commercial white types.

A number of hybrids among the rice types are available; but, in general, these hybrids are lower in yield than the pearl-type hybrids. Some people prefer the rice types over the pearl types, believing that they produce a popped corn of higher quality. If desired, these types can be grown successfully in a home garden, but they are not so suitable for the market.

The Iowa Agricultural Experiment Station has two rice-type hybrids, *Iopop 5* and *Iopop 7*, in commercial production. Both of these hybrids are of Jap Hulless extraction and produce high quality popped corn. However, they yield 20 to 50 percent less than the pearl-type hybrids under Missouri conditions.

Cultural Methods

Popcorn can be grown on soil suited for dent corn. It will respond to fertilizer treatment in the same manner as field corn; and, in gener-

PEDIGREE, COLOR, TYPE, MATURITY, AND LODGING OF OPEN-PEDIGREE HYBRIDS RECOMMENDED BY THE MISSOURI AGRICULTURAL EXPERIMENT STATION.

Hybrid	Pedigree	Color and Type	Maturity	Lodging
<i>Purdue 22</i>	Sg 16 x Sg 18	Yellow pearl	Medium	Medium
<i>Purdue 31</i>	(Sg 16 x Sg 18 x SA24)	Yellow pearl	Medium late	High
<i>Purdue 32 (K4)</i>	(Sg 18 x Sg 30A) x SA24	Yellow pearl	Medium late	Low
<i>Purdue 213</i>	(Sg 18 x Sg 1533) x Ia28	Yellow pearl	Medium	High
<i>Purdue 303</i>	(Ia27 x Ia29) x WR4533	White rice	Medium	Medium
<i>Purdue 406</i>	(Sg 18 x Sg 1533) x KP58	Yellow pearl	Medium late	Low
<i>Iopop 6</i>	(Sg 18 x Sg 30A) x Ia28	Yellow pearl	Medium	High
<i>Iopop 8</i>	(Sg 18 x Sg 30A) (Ia28 x Ia61)	Yellow pearl	Medium	High

al, the methods that are successful in field corn culture also will apply to popcorn. Since popcorn produces a smaller plant, it may be planted thicker than field corn. The best rate is about 14,000 to 18,000 plants per acre. However, the prolific hybrids may be planted at the same rate as field corn (12,000—14,000).

Popcorn usually is drilled and, because of its small plants, cannot compete with weeds as well as field corn. Therefore, a thicker stand and good cultivation supplemented by 2,4-D are recommended on weedy ground. For information on weed control with chemicals, write the Department of Field Crops, Waters Hall, Columbia, Mo., or see your county agricultural agent.

The insects which damage dent corn, such as European corn borer, corn earworm, and corn rootworm, also damage popcorn. Control measures recommended for the control of these insects in field corn are applicable to popcorn.

Harvesting

Harvesting popcorn by hand is laborious. Practically all large commercial acreages are harvested with mechanical pickers. Special popcorn rollers enable mechanical pickers to pick the crop more efficiently. Some growers have had success in harvesting with combines. It is desirable to harvest popcorn when the moisture content of the grain is about 15 to 17 percent. Complete maturity of the crop is essential, and planting should be early enough to give plants time to mature before a killing frost.

In some sections of Missouri, especially the southeast, weevils and Angoumois grain moths will infest the crop while it is in the field. Immediate harvesting is necessary when infestation occurs, and the corn should be stored in tight bins and fumigated.

Drying and Storing

Under Missouri weather conditions, popcorn usually dries in the field to the correct moisture content, but the crop should not be allowed to remain in the field until it becomes too dry for popping.

In some cases when the crop is late in maturing, artificial drying may be necessary. Artificial drying also enables the grower to move the corn into market channels earlier, thereby avoiding losses in storage from rodents and insects. Artificial drying must not be too fast since a rapid loss of moisture reduces popping expansion. The maximum temperature should not exceed 90° F. Drying bins can be built with dry, heated air circulating through them. Before a grower attempts to build a drying bin, he should consult agricultural engineers at the University of Missouri who have had experience in this type of construction.

Popcorn should be stored on the ear until it reaches 15 to 17 percent moisture. Storage methods should prevent damage by rats, mice, and weevils. Remove all diseased and damaged ears before shelling. Popcorn should not be shelled until it reaches the desired moisture content; it should be placed in moisture-proof containers soon after it is shelled.

Fumigation

Where weevils are evident, it is desirable to fumigate with a gas that will not affect the taste of the popped corn. Naphthalene crystals or mothballs cannot be used, since they impart an unpleasant taste to the popped corn. A fumigant free from this disadvantage is carbon tetrachloride. Use 1 ounce to every 3 cubic feet of space in an air-tight barrel, box, or bin in which the shelled popcorn is stored. It can be placed in a container or a cloth soaked with it and placed in the top of the barrel, box, or bin.

Adjusting Moisture for Maximum Popping

Many people do not realize why their popcorn fails to pop well. The trouble usually is too much or too little moisture in the popcorn.

An easy way to bring popcorn to the right moisture content is to hang it outside for about 2 months during the winter. An occasional popping test is the most practical method of determining when the moisture content is satisfactory.

After the popcorn has reached the right moisture content, it should be stored in airtight containers, or stored in a refrigerator or deep freezer. This type of storage has the advantage of preventing damage by weevils.

Another way to raise the moisture content is to add water directly by placing the kernels in a fruit jar or coffee can and add 1 to 2 table spoons of water to each quart of corn. The corn must be thoroughly stirred as soon as the water is added, to insure uniform distribution. The container should be closed tightly and let stand a few days until the moisture has had time to penetrate the kernels.

Popcorn that contains too much moisture may be dried by hanging it in a heated room. It will dry rapidly so it should be test-popped frequently and stored before it gets too dry.

Is There a Profit in Producing Popcorn?

The 10-year average gross income from dent corn in Missouri, 1948 to 1957, was \$54.63 per acre and \$57.72 from popcorn. Although the average difference was \$3.09, there was considerable fluctuation from year to year, ranging from \$55.16 more income per acre from popcorn in 1948 to \$17.31 more income per acre from dent corn in 1955. Popcorn had a greater gross income during 6 of the 10 years. The difference in gross income between popcorn and dent corn will continue to fluctuate from year to year. However, the difference in net returns for the two crops may be expected to average

about the same over a 10-year period.

The higher return for popcorn may be offset to some extent by additional cost involved in drying popcorn to the proper moisture content, prevention of rodent and weevil damage, the culling of diseased and damaged ears, and a slightly higher harvesting cost.

The question of marketing will arise. Many of the larger popcorn companies contract acreages in certain areas, assuring the local producer of a market. A grower who depends upon a local market should be careful not to produce more than he can sell.