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# IOWA CORN RESEARCH INSTITUTE

POLICY, ORGANIZATION AND PROJECTS



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## Foreword

**T**HE initiation of the Iowa Corn Research Institute as an integral part of the Iowa Agricultural Experiment Station and of the Iowa State College would seem to merit a clear statement of its purposes, organization and plans. This booklet has been prepared to answer the questions which may arise as to its objectives and aims.



## IOWA CORN RESEARCH INSTITUTE

### OBJECTIVES:

1. To encourage and coordinate all corn (maize) research in Iowa, and to increase its usefulness.
2. To obtain adequate recognition of the importance of such research and obtain increased support for it.

### REASONS FOR ORGANIZATION AT IOWA STATE COLLEGE:

1. Corn is the most important of Iowa crops and is the primary basis for much Iowa wealth. Iowa is a logical center for research.
2. Iowa utilizes directly in feeding and in industry a large proportion of the corn produced within the state.
3. Some of the largest units of the corn manufacturing industries with their numerous research problems are located in Iowa.
4. An extensive program of research on corn is already under way in Iowa.
5. Extension and coordination of this program with increased cooperation among all research agencies are highly desirable.

### ORGANIZATION:

The Iowa Corn Research Institute is primarily a staff of research workers interested in problems relating to corn in Iowa, with a small coordinating executive committee and a larger advisory committee.

**Executive Committee.** The executive committee consists of the Vice Director (designated as chairman during the organization phases of the Institute) of the Agricultural Experiment Station, the Director of the Station and two members of the resident staff chosen from the advisory committee, at least one representing the United States Department of Agriculture. There may also be appointed an executive secretary.



**Advisory Committee.** The advisory committee is expected to assist actively in the development of the program of the Institute. It consists of:

1. The director of the Iowa Agricultural Experiment Station, chairman.
2. Administrative officers of the Iowa State College in charge of various phases of agricultural work, the Dean of Agriculture, the Director of Agricultural Extension, the Assistant in Agriculture to the President, and the Vice Director of the Agricultural Experiment Station.
3. Chiefs of Bureaus and heads of Divisions of the United States Department of Agriculture actively cooperating in this program, or representatives selected by them.
4. Heads of Sections and Subsections of the Iowa Agricultural Experiment Station actively participating in the corn research program.
5. Representatives of such Iowa or national agricultural organizations and of such industries directly concerned with corn and its utilization as desire to cooperate and are admitted or chosen by the Executive Committee. Among those who may be interested are the Iowa Corn and Small Grain Growers' Association, the wet corn milling industry, the dry corn milling industry, the corn canning industry, the industries producing chemicals from corn by fermentative processes. Industrial representatives will be nominated by their national trade organizations.

**Staff.** The Staff shall include all members of the Iowa Agricultural Experiment Station staff who are supervising or are actively engaged in this program, and members of the staffs of the various Bureaus of the United States Department of Agriculture who are collaborating on this program, and such members of other staffs of Iowa State College or of other research organizations as are engaged in corn research and are desirous of cooperating.

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## PROGRAM:

1. Make a systematic survey of the work now under way in Iowa and elsewhere on corn, emphasizing particularly the work of the Iowa Agricultural Experiment Station and that of the United States Department of Agriculture.
2. Prepare and publish such indexes to the literature and to research on corn as may be desirable.
3. Make a careful survey of the work which should be undertaken in corn research. Include both agricultural and industrial phases.
4. Review the projects of the Station in cooperation with the United States Department of Agriculture.
5. Prepare and revise such cooperative agreements or memoranda of understanding with the appropriate Bureaus of the United States Department of Agriculture as may be desirable.
6. Obtain funds needed for the adequate organization of the program as far as possible.
7. Hold such meetings and conferences of staff and advisory committees as may be necessary to keep all workers apprised of progress.
8. Make provision for adequate cooperation with societies and industries concerned with corn.
9. Publish as bulletins of the Iowa Agricultural Experiment Station or through other channels the results of the studies.

## ELEVEN SUGGESTED FIELDS OF RESEARCH:

1. Soils and soil management as related to corn production.
2. Cultural methods and equipment for corn production.
3. Corn breeding.
4. Botany of corn (including physiology, ecology, morphology and cytology).

5. Pathology and mycology of corn (corn diseases).
6. Insects of corn.
7. Corn composition. Chemistry and characteristics as a raw product.
8. Industrial utilization of corn.
9. Corn and corn products in human and animal nutrition.
10. Corn economics.
11. Corn bibliographies and literature, including history.

### Outline of Suggested Fields of Investigations:

The following is an attempt to outline the subdivisions of the 11 suggested fields of research for the Institute. It is necessarily incomplete, but should give a resumé of the scope of the work conceived as appropriate to development. Studies in many of the fields outlined are already under way by various Sections of the Iowa Agricultural Experiment Station, in many cases in cooperation with various Bureaus of the United States Department of Agriculture.

#### 1. Soils and Soil Management as Related to Corn Production

Iowa contains a relatively high percentage of land well adapted to the production of corn. There are numerous problems relating to corn and soils.

- A. **Soil Surveys.** Fundamental to a classification of soils and identification of those adapted to the production of corn is the completion of the soil survey of Iowa. By July 1, 1934, surveys of 84 of the 99 counties had been completed. Probably 4 additional counties will be completed in 1934-35. It is highly desirable that the remaining 11 counties be surveyed in the 2 succeeding years. This work is cooperative between the Bureau of Chemistry and Soils of the U. S. D. A. and the Soils Subsection of the Station. The exact area of each soil type by townships is being obtained. The following 4 counties are now being surveyed: Cerro Gordo, Jackson, Decatur and

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Story. The following 11 counties are still to be surveyed: Keokuk, Lucas, Taylor, Allamakee, Iowa, Adams, Shelby, Tama, Humboldt, Cass and Monona.

**B. Soil Fertility and Crop Rotation as Related to Corn Yield.** The influence of manures and fertilizers and of crop rotations is being studied on the principal soil types, likewise the effect of various methods of soil management. Numerous plot experiments are under way. Cooperative studies between the Bureau of Chemistry and Soils, U. S. D. A., the Soils Subsection and the Agricultural Engineering Section have been undertaken on the relationship of corn and of rotations containing corn on soil erosion, particularly at the Page County Soil Erosion Experimental Farm. The following projects of the Station relate to these problems:

194. The Effects of Fertilizers on Crops and Soil Conditions under Various Rotations in the Wisconsin Drift Soil Area.
196. The Effects of Various Amounts of Fertilizers Applied at Different Times in the Rotation on Crops and Soil Conditions in the Wisconsin Drift Soil Area.
- 200-214, 217. The Effects of Various Fertilizing Materials on Crop Growth on the Various Soils and on the Chemical and Bacteriological Conditions in the Soils. These soils are Carrington, Grundy, Clarion, Tama, Muscatine, Clinton, Marshall, Terrace, Bottom, and Webster.
228. The Plant Food Content and Lime Requirements of Iowa Soils and the Composition of Various Crops.
232. Studies on Soil Erosion on the Marshall Silt Loam in Page County, Iowa.
308. The Character, Fertilization and Management of High Lime and Alkali Soils of Iowa.
368. Trials of the Basin Method of Planting Corn on Representative Soil Areas of the State.

## 2. Cultural Methods and Equipment for Corn Production

- A. **Methods and Equipment for Seedbed Preparation, Planting and Cultivating.** The Agricultural Engineering Section, the Farm Crops Subsection and the Bureau of Agricultural Engineering, U. S. D. A., are cooperating actively in a program on the machinery and power problems involved in corn production.

The practical utilization of the results of studies being made upon the corn plant by other sections whose staffs are studying weeds, diseases, pests and the ecology of the corn plant is a major function of this section. The projects active in this field at present are:

- 22. An Economic and Engineering Study of Corn Production Methods in Iowa.
- 154. A Comparison of Surface, Furrow and Listed Planting of Corn.
- 368. Trials of the Basin Method of Planting Corn on Representative Soil Areas of the State.
- 392. Accuracy of Four-Row Corn Check Rowers.
- 395. Seedbed Preparation for Corn.

- B. **Methods and Equipment for Corn Harvesting.**

- 22. An Economic and Engineering Study of Corn Production Methods in Iowa.
- 393. Wagon and Trailer Hitches.
- 394. Efficiency of Corn Pickers.

- C. **Methods, Equipment and Buildings for Curing and Storage of Corn.** The Agricultural Engineering Section, the Farm Crops Subsection and the Bureau of Agricultural Engineering, U. S. D. A., are also actively cooperating on the solution of power and machinery problems involved in this program. The results of studies on varieties, rate of planting, respiration of stored grain and fermentation of silage carried on by other sections should be interpreted in terms of machinery and suitable curing and storage facilities and methods. The following projects are now under way.

- 192. Curing and Storage Studies with Corn and Small Grains.

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D. **Corn Production as Related to Weeds and Their Eradication.** The Botany and Plant Pathology Section has undertaken highly specialized studies on certain of the most serious field pests of north-west Iowa. Such studies are basic to proper cultural practices. The following projects are under way:

303. Factors Determining the Annual Spread of *Convolvulus arvensis* (Creeping Jennie) and *Euphorbia esula* (Leafy Spurge).
304. Methods of Destroying Localized Areas of Noxious Weeds, Particularly Creeping Jennie and Leafy Spurge.

The Agricultural Engineering Section has the following project under way:

396. Weed Control in Growing Corn.

E. **Corn Production as Related to Seed, Time of Planting, and Adaptation.** Obviously research on such problems integrates work in several sections, as Farm Crops, Soils, and Botany and Plant Pathology, including the Seed Laboratory. The Bureau of Plant Industry is cooperating, also the Iowa Corn and Small Grain Growers' Association. The following projects are being studied at present:

86. Investigations of Seed Germination.
161. A Study of Different Varieties and Strains of Corn in Different Parts of Iowa.
162. The Relation of Time of Planting to Yield and Quality of Produce Among Crosses Between Inbred Lines of Corn.
177. Rate, Date and Method of Planting Varieties of Corn Differing in Maturity.
178. Ear and Kernel Characteristics of Seed Corn in Relation to Yield.
181. The Growth Response of Corn Hybrids and Varieties on Soils of Different Levels of Fertility and on Various Soil Types.



### 3. Corn Breeding

This constitutes one of the most important fields of investigation for the Corn Research Institute. The cooperation of the Bureau of Plant Industry, U. S. D. A., should be particularly stressed, for the men of this Bureau have been collaborating on numerous Station projects. Much of the work on field corn and pop corn breeding has been under projects of the Farm Crops Subsection, that on sweet corn in the Vegetable Crops Subsection. The Genetics Section has been carrying on several important studies, and has served to coordinate and integrate the scientific aspects of the work of the various sections interested. In some phases of breeding, as in development of disease resistant strains and in cytology of inheritance the Botany and Plant Pathology Section must perform important functions.

- A. **Collection and Preservation of Types and Varieties of Corn.** It is obvious that progress in corn breeding depends upon: (1) Selecting and combining desirable genes discovered in the various inbred lines, and in various strains and varieties; (2) Possible stimulus of mutations which may be desirable. In order to carry out the former objective it is essential that provision be made for bringing together as many varieties and types of corn as possible, so that there may be material available for the development of inbred strains, and to serve as a reservoir of germ plasm. It is probable that many trials should be made of various types of corn, and careful observations made of characters which might be of value. Provisions for preservation of these strains should be made, utilizing the facilities of the U. S. D. A., the Iowa Agricultural Experiment Station and the other agricultural experiment stations of the country. There should be provision for preserving the inbred lines developed both here and elsewhere. One project now under way is the following:
164. The Maintenance of Pure Seed Sources of Improved Corn Crop Varieties Through Field Inspection and Certification.
- B. **Development of Pure Inbred Lines.** The development of a homozygous strain of corn apparently eliminates many undesirable qualities, and crosses of certain inbreds give highly desirable

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commercial corns. These hybrids which show unusually promising characteristics may in turn serve as a starting point in the development of better inbred strains. The Bureau of Plant Industry, Farm Crops Subsection, Genetics Section and Vegetable Crops Subsection are all engaged in development of inbred strains. The projects are as follows:

163. Corn Improvement Through the Use of Inbred Lines.

293. Sweet Corn Breeding.

C. **Development of Hybrids and Varieties Commercially Significant.** The most important criterion used in developing better varieties of corn has been that of yield. Thus far the development of hybrids which would be particularly useful in special industries and in feeding has been stressed somewhat less. Among the numerous special types which should be developed are:

- (1) Corn high in protein for feeding.
- (2) High starch corn for starch making and for the corn products industry.
- (3) Special ensilage corns.
- (4) Early maturing corn.
- (5) Drouth-resistant corn.
- (6) Corn adapted to special soils or levels of soil fertility.
- (7) Special pop corn.
- (8) Special sweet corns.
- (9) Homozygous strains for study of physiology.
- (10) Corn resistant to diseases.
- (11) Corn resistant to insect pests.

Among the projects now under way by the Bureau of Plant Industry, Farm Crops Subsection, Genetics Section, Botany and Plant Pathology Section and Vegetable Crops Subsection are the following:

155. Comparison of Inbred Lines of Corn Obtained from Open-Pollinated Varieties and from Crosses Between Inbred Lines.

159. Correlation Between Composition and Stiffness of Stalk in the Corn Plant.

163. Corn Improvement Through the Use of Inbred Lines.
293. Sweet Corn Breeding.
321. The Production and Distribution of Seed of Corn Hybrids and of the Parents From Which They Are Derived.
345. Breeding and Cultural Studies With Pop Corn.
411. Improving Inbred Lines of Corn by Crossing Followed by Selfing and Sibbing.

D. **Corn Genetics.** The number of distinct genes that have been recorded for corn is large, and rapidly increasing. The modes of inheritance have been studied for many. One function of the Corn Research Institute is to further the cataloging of these characters, to determine linkages, location of genes on chromosomes, etc. This must be worked in close cooperation with the cytologists. Much of this work is a by-product of other studies; most of those who are engaged in corn breeding will always have more or less work of this type under way. The problems are so numerous and so intricate that it will require many years on the part of workers on corn in many places to make possible a relatively complete picture. Projects at present under way by the Bureau of Plant Industry, Genetics Section, Farm Crops Subsection and Vegetable Crops Subsection are as follows:

182. Genetic Investigations with Corn.
250. Genetic Interrelations and Prepotencies of Inbred Lines of Corn.
404. Genetic Investigations of Bacterial Wilt Resistance in Corn.

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#### 4. Botany of Corn

Under this heading are to be grouped those studies which relate more specifically to the morphology, cytology, physiology and ecology of the corn plant. These studies must constitute the basis for many of the breeding and production studies.

- A. **Morphology.** A monographic treatment of the gross morphology of the corn plant is desirable. It should include accurate descriptions of the variations in morphology to be expected among the various types of corn. There should be an accurate description of the morphology which is the expression of the activity of each gene. Similar studies and compilations are needed for the microscopic anatomy of the corn plant.
- B. **Cytology.** The remarkable recent correlation of cytologic and genetic findings in corn require that adequate cytologic assistance be given to those engaged in corn breeding investigations.
- C. **Physiology.** Work on physiology of the corn plant has been handicapped until recently because of the high degree of heterozygosity of the material. The development of inbred strains makes possible work on the physiology which is more reliable than that on other material. Corn is in many respects particularly well adapted to fundamental studies in plant physiology. The projects under way are:
- 94. A Study of the Pathogenicity of *Basisporium gallarum* to Corn.
  - 181. The Growth Response of Corn Hybrids and Varieties on Soils of Different Levels of Fertility and Various Soil Types.
  - 390. Effect of Organic Mercury Dusts on Seeds of Corn, Oats, Barley and Flax.
- D. **Ecology.** Strictly speaking, ecology is a subdivision of physiology. It is commonly used as a term, however, to designate the relationships of plants to their environment, particularly under field conditions. Studies on effects of mechanical injuries upon the corn plant, relationships to weeds and their toxic products, competition

among plants, etc., should be investigated. One project is under way:

89. The Measurement of the Limiting Environmental Factors in the Growth of the Corn Plant at Different Rates and Spacings.

## 5. Pathology and Mycology of Corn (Diseases of Corn)

Corn is subject to numerous fungous and bacterial parasites, some of considerable economic importance. The field of corn pathology may be somewhat arbitrarily divided under the following headings:

- A. **Fungi Which Attack Corn.** Some of these attack the germinating seed, some the growing plant, some the ear and the maturing kernels, others are responsible for deterioration of stored grain, and still others (probably beneficial on the whole) bring about decomposition of stalks in the soil. The isolation and identification of the fungi and a study of their physiological characters is important. Projects under way are the following:

69. Inheritance of Resistance to Basisporium Ear Rot and Seed Rotting and the Relation of These Characters to Yield.
85. A Survey and Identification of the Fungi Occurring on Cornstalks and Their Effect Singly and in Combination on Cornstalk Tissues.
92. A Study of the Factors Influencing Resistance of Strains of Corn to *Ustilago zaeae*.
93. Study of Diplodia Dry Rot of Corn.
95. A Study of the Pathogenicity of *Basisporium gallarum* to Corn.

- B. **Bacteria Which Attack Corn.** One or more diseases of corn is caused by bacteria. One project under way is:

404. Genetic Investigations of Bacterial Wilt Resistance in Corn.

- C. **Virus Diseases of Corn.** Apparently corn in the Corn Belt is relatively free from virus diseases, but a careful survey should be undertaken, to determine incidence and effects.

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- D. **Physiological Pathology of Corn.** Parasites, environment and perhaps in some cases inheritance may induce abnormal or harmful physiologic responses on the part of the corn plant.
- E. **Pathological Anatomy of Corn.** The corn plant is modified anatomically by parasites and unfavorable environment. The plant responses should be studied. The following project is under way:
92. A Study of the Factors Influencing resistance of Strains of Corn to *Ustilago zeae*.
- F. **Methods of Combating Diseases of Corn.** Germicidal dusts and treatment of many types are being introduced to protect germinating seed. There is much room for study in the improvement of these. There is opportunity also for coordination of pathology and plant breeding in the development of resistant strains of corn as this seems to be of primary importance in disease control in corn. Projects under way are:
94. Physiological Response of the Growing Plant and the Pathogene to Chemical Treatments of Seed Corn.
163. Corn Improvement Through the Use of Inbred Lines.
390. Effect of Organic Mercury Dusts on Seeds of Corn, Oats, Barley and Flax.

## 6. Insects of Corn

Insects in some cases become the limiting factor in the production of corn. Some are specific for corn, or particular parts of the corn, others are non-specific and attack a number of host plants.

- A. **Corn Insect Surveys.** It is necessary that observations be made each year upon the species of insects destructive to corn, that they be identified and that the damage be assessed. While not fundamental research, such surveys are needed, and frequently give leads to important research.
- B. **Life History Studies.** Careful life histories should be determined for all corn insects under the conditions prevalent in Iowa. These should be supplemented by studies under controlled laboratory conditions. Eventually they should be



monographed. Such life history studies are essential to proper development of control measures. Projects under way are:

- 128. White Grub Investigations.
- 134. Cornstalk Borers.
- 323. Ecology and Control of Sod Webworms in Permanent Pasture and Cultivated Fields.
- 372. Emergency Insect Investigations.
- 420. Bionomics and Control of the Chinch Bug (*Blissus leucopterus* Say).

C. **Physiology and Toxicology of Corn Insects.** Intensive studies on conditions limiting the life of corn insects should be carried on. These may lead to practical control measures. Projects under way are:

- 136. Nutrition and Metabolism of Insects (Largely Insects Attacking Stored Grain and Foods).
- 137. Insects and Insect Toxicology.
- 420. Bionomics and Control of the Chinch Bug (*Blissus leucopterus* Say).

D. **Control Measures.** Methods of controlling insects injurious to corn can be effective only when backed by the knowledge received through surveys, life history studies and studies of physiology and ecology. One of the promising lines of attack is by breeding strains of corn resistant to the attacks of the insect pests such as earworms, chinch bugs, European corn borer, etc. Projects under way are:

- 128. White Grub Investigations.
- 163. Corn Improvement Through the Use of Inbred Lines.
- 323. Ecology and Control of Sod Webworms in Permanent Pastures and Cultivated Fields.
- 420. Bionomics and Control of the Chinch Bug (*Blissus leucopterus* Say).

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## 7. Corn Composition (Chemistry and Characteristics as a Raw Product)

Basic to utilization of corn for feeding or for industrial purposes is an adequate understanding of the composition of the corn plant and of all its parts. Methods and techniques must be assembled and developed and laboratory facilities provided which will give this essential information promptly with reference to any sample or specimen submitted. The ability to obtain this information promptly is of great value to the corn breeder.

### A. Mechanical Analysis and Separation of Corn.

One of the first needs of the Corn Research Institute is an adequate laboratory well equipped with such miniature mills and apparatus as are necessary for both dry milling and wet milling of corn. It should be provided with equipment for the mechanical separation of the parts of the corn kernel and for the rapid determination of the percentages of each of the major constituents as these are separated in commercial plants. This laboratory will be primarily a service unit. Among the uses of this plant will be the following:

- (1) *For Genetics and Breeding of Corn.* In order that definite direction can be given to those engaged in corn breeding it is necessary that small samples be quickly and accurately analyzed and percentage composition determined. The development of varieties or strains of corn of special value for particular purposes must be thus guided. Laboratories for assisting the breeders of wheat and barley have been developed at other institutions. These give milling, baking, malting and other characteristics, but there are no entirely adequate facilities for corn.
- (2) *For Studies of Nutritive Characteristics of Corn.* The laboratory will make possible the mechanical separation of the various parts of the corn kernel for any type of corn, and render these constituents available for feeding of animals experimentally and for an adequate determination of the nutritive value.

(3) *For Studies on Industrial Uses.* It will be possible to provide an adequate supply of corn constituents to serve as a starting point in a search for increased or new industrial uses.

(4) *For Studies on Chemistry of Corn.* The laboratory will supply in quantity constituents of corn which may be studied intensively as to their chemical composition and characteristics.

**B. Chemical Composition of Corn and of the Corn Plant.** There should be some expansion in work in plant chemistry. Improved techniques for the separation and identification of carbohydrates and lignins are now available. There should be additional methods developed for recognition and quantitative determination of all the plant constituents. Some of these will enable the geneticist and physiologist correctly to determine what the exact difference is between different types of corn, as between waxy and flinty endosperm. Work is needed on starches, hemicelluloses, celluloses, pentosans, dextrans, sugars, fats, fatty acids, lipoids, proteins, pigments, etc. Projects under way are:

159. Correlation Between Composition and Stiffness of Stalk in the Corn Plant.
309. Identification of the Water-Soluble and the Acid Hydrolyzable Carbohydrate Constituents (Hemicelluloses) of the Cornstalk and the Development of Methods for Their Analysis.
347. Carbohydrate Content of the Various Farm Crops.

**C. Chemical Analysis of Corn Derivatives.** There is a real need in food chemistry for the development of adequate and reliable qualitative and quantitative methods for determination of the constituents of corn products, particularly food products and products used extensively in industry. Even the glucose sirups sold as human foods are analyzed inadequately and unsatisfactorily at present.

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## 8. Industrial Utilization of Corn

It is evident that this field is quite dependent for its development upon progress in certain of the preceding fields. Chemical knowledge of the raw material is desirable, and mechanical analysis should be helpful in determining industrial utilization.

It is recognized that there exists already at Iowa State College a cooperative laboratory with the United States Bureau of Chemistry and Soils for study of utilization of agricultural wastes. It is recognized also that the Department of Chemical Engineering, the Engineering Experiment Station, the Department of Chemistry and possibly other departments of Iowa State College have been working on certain phases of industrial utilization of corn. Care must be used either to avoid duplicating programs or to cooperate in problems of mutual interest. In some cases it may be wise to draw an entirely arbitrary line of demarcation, in other cases to join forces in an attack on a problem. The following are some of the principal subdivisions of this field which require exploration by the Corn Research Institute.

**A. Industrial Utilization of Field Corn.** Increased use of corn by industry would be of major significance to Corn Belt agriculture.

- (1) *Preparation for feeds.* A large amount of corn is now processed; animal feeds are among the major products. These show great variation in composition and usefulness. Studies looking to the improvement of these feeds should be made. Digestibility, for example, might be markedly improved. Uniformity could be increased.
- (2) *Preparation for human food.* Human foods from corn are now prepared in great variety. Undoubtedly improvements in techniques and in quality may be obtained. There is here an excellent opportunity for cooperative work between food chemistry and home economics.
- (3) *Utilization for purposes other than as feeds or foods.*

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(a) *By fermentative processes.* Work in the Bacteriology Section has been carried on for many years. The Agricultural By-Products Laboratory and the Department of Chemistry have also carried on some work in this field. It is one which may be somewhat enlarged. The list of possible chemical products is relatively long. Corn is an admirable substrate for study. Projects under way are:

65. Fermentation Products of Xylan.

85. A Survey and Identification of the Fungi Occurring on Cornstalks and Their Effect Singly and in Combination on Cornstalk Tissues.

421. Utilization of Agricultural Products in the Fermentative Production of Lactic Acid.

(b) *By various chemical and mechanical treatments.* Modification of starches, hemicelluloses, pentosans and proteins should be particularly sought. These phases will be emphasized in the Plant Chemistry Subsection.

B. **Industrial Utilization of Sweet Corn.** Primarily sweet corn will be used for canning. It is possible other uses might be found. This may be determined by the outcome of studies instituted under No. 6, above.

C. **Industrial Utilization of Cobs.** The work on cobs has been carried on largely in the Agricultural By-Products Laboratory, the Department of Chemical Engineering, the Department of Chemistry, the Department of Bacteriology and the Bacteriology Section. It is probable that much of the work will continue to be carried by the Agricultural By-Products Laboratory, the Bureau of

Chemistry and Soils, U. S. D. A., and the Engineering Experiment Station cooperating. Care should be exercised to prevent unnecessary duplication.

- D. **Industrial Utilization of Stalks.** Considerable work in the field has been carried on by the Department of Agricultural Engineering, the Agricultural By-Products Laboratory, the Department of Chemical Engineering and the Department of Chemistry. Some studies have been made by the Soils Subsection.

## 9. Corn and Corn Products in Human and Animal Nutrition

### A. Nutritive Characteristics of Corn and Its Products.

1. *With Reference to Nutrition of Laboratory Animals.* The basic facts with reference to nutrition have been developed largely by the modern technique of laboratory feeding of test animals. Various phases of this project have been and are being worked by several laboratories. The Animal Chemistry Subsection and the Foods and Nutrition Subsection of the Agricultural Experiment Station and the laboratory in Physiological and Nutritional Chemistry of the Department of Chemistry are concerned.

A list is appended indicating some of the problems which need solution:

- (1) The vitamin content of corn silage.
  - (2) The relative digestibility of corn gluten and steep water protein.
  - (3) The vitamin content of corn and its by-products,
    - (a) The pigments of the corn kernel in relation to vitamin A.
    - (b) Reason for the difference between vitamin A value of crude and refined corn oils.
2. *With Reference to Human Nutrition.* It is not improbable that certain phases of the



relationships of corn to human nutrition should be studied using human subjects. This is a legitimate phase of work for the Foods and Nutrition Subsection.

3. *With Reference to the Nutrition of Domestic Animals.* Numerous studies have been made in the past with reference to the use of corn, corn stover, corn silage, etc., in feeding livestock, including swine, beef cattle, dairy cattle, sheep and poultry. These have been carried on in the various subsections of the Animal Husbandry Section. The development of the corn laboratory will enable these subsections to make much more careful and intensive studies on different types of corn and on carefully prepared corn ingredients than has been possible in the past. This is an important phase of the work. The supplementing of the corn protein with suitable amendments is highly desirable. The following projects are active.

40. The value of Yeast and Prepared Yeast Feeds in Supplementing a Grain—"Big 10" Ration for Fattening Pigs on Rape Pasture.
41. The Relative Efficiency of Different Types of Corn for Growing and Fattening Pigs.
42. The Relative Efficiency of High and Low Protein Supplemental Feeds for Gilts During the Gestation and Suckling Period.
401. Rations for Finishing Steer Calves in Drylot.

B. **Corn and Its Preparation as a Human Food.** Extensive studies should be made upon such problems as the desirability of increased use of dextrose as a sugar, the use of starches in food preparation, the uses of corn oil, germ meal, corn meal, etc. Foods and Nutrition Subsection may undertake important studies. It is quite possible that careful study would reveal possibilities of increasing use of corn and its products in human food.

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## 10. Corn Economics

Many problems are under investigation and many others should be studied largely through the activity of the Agricultural Economics Section. This section is in active collaboration with others as Farm Crops and Soils, and Animal Husbandry, and with the Bureau of Agricultural Economics, in determination of the role which corn should play in the rehabilitation of Iowa agriculture. It is charged with the problem of determining the possible increases in industrial utilization of corn. It has numerous interests in the marketing of corn, the competitive position of corn, corn movements, corn prices, etc.

**A. Supply and Production of Corn.** The supply of corn is related directly to the cost of producing corn. At what price will and can farmers produce an adequate supply? What are the principal cost determinants? Further studies are necessary to measure the supply elasticity of corn, especially from the cost angle. Two lines of approach are highly worth while.

(1) *The position of the corn enterprise in the production economy of the farm.* The corn producing area of the United States can be classified roughly into three zones: (a) the zone in which corn comprises first place in the farm organization; (b) the zone in which alternative feed crops of approximately equal value can be produced; and, (c) the area wherein corn is strictly a minor enterprise, supplementary in character. The competitive role of corn in each of these zones should be studied.

(2) *Competitive aspects of the geographical regionalization of corn production.* Shifts in corn producing areas; expansion of alternative feed crops, like barley and grain sorghums; influence of increased technical efficiency in production; probable effect of lessened demand for animal fats, particularly lard, require attention. The following projects of the Experiment Station bear on this problem.

2. Elasticity of Supply of Corn and Hogs for the Different Type of Farming Areas in Iowa.
22. An Economic and Engineering Study of Corn Production Methods in Iowa.
79. Certain Competitive Phases of Corn Production.
312. A Study of the Major and Minor Types of Farming Areas in Iowa.

**B. Demand and Disposition of Corn.** Some progress has been made in ascertaining the several factors affecting the demand for corn. Studies to determine the relative importance of the factors and the changes each is undergoing are much needed. Research work along three lines is desirable.

1. *Agricultural demand for corn.* Most of the corn crop is used for livestock purposes. It is necessary to estimate both the present and prospective amount of corn that is and will be consumed by hogs, cattle, horses and mules, dairy cows, sheep and poultry.
2. *Industrial demand for corn.* Little is known about the competitive position of corn as a raw material for industrial purposes. Possibilities of expanding the industrial demand for corn should be carefully investigated both from the technical and economic viewpoint.
3. *Direct human demand for corn.* A study of the decline in the per capita consumption of corn by geographical regions is needed. Why is corn rapidly disappearing from the diet of the American people? Special attention should be given to the dietary changes of southern people and, also, to the diet trends of urban people. One study is now under way:

369. Agricultural and Industrial Utilization of Corn.

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C. **Corn Prices.** Corn, along with hog prices, has proved to be one of the more fruitful fields for price analysis. Studies are along the following lines.

- (1) *Factors affecting corn prices.*
- (2) *Characteristics of corn price movements.* Seasonal, annual, and secular movements are distinguished.
- (3) *Geographical variations.*

Considerable work has been done on corn prices in connection with former project Number 20.

D. **Corn Marketing and Transportation.** The problems of corn marketing involve both private and public interest. While considerable advances have been made in understanding the functions of the marketing processes, much work still needs to be done in examining market maladjustments.

- (1) *Function of farmer elevators in corn marketing.*
- (2) *Influence of organized speculation on the price of corn.* Work is needed on the interrelation of long and short holdings, "corners" and the technical position of leading speculative operators.
- (3) *Price leadership and price interaction among the major feed grains.* What is the price interrelationship of the principal futures markets dealing in coarse feed grains? To what extent does the futures market dictate the course of the cash grain market?
- (4) *Price spreads between surplus and deficit corn producing areas and the domestic movement of corn.*
- (5) *Probable effect of the projected waterways in North America upon the domestic movement of corn.* The proposed St. Lawrence waterway will have, if and when completed, considerable influence upon the economic cost of moving corn from the surplus areas, which are represented primarily by the northwest-

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ern Iowa and central Illinois cash grain farming areas, to the deficit feeding areas in the eastern United States. What effect a change in the cost of transportation ratio between hogs, dressed meat, and bulky, raw material corn will have upon the type of farming areas and relative profitability of cash grain farming as against livestock farming requires careful analysis.

The following projects are being studied at present:

9. Grain Price Differentials Between the Surplus Producing Areas of Iowa and the Deficit Producing Areas.
336. Grain Handling Methods of Iowa Farmers' Elevators.
378. Economic Significance and Importance of Farmers' Elevators in Iowa Grain Trade.

### E. Foreign Competition and International Commerce in Corn and Corn Products.

- (1) *Argentina as a producer and exporter of corn.* Although the Argentine produces only one-tenth as much corn as the United States, it clearly dominates international trade in corn. Research work is needed to ascertain the relationship of feed prices in Europe to the corn crop in the Argentine; and, in turn, the influence of the Buenos Aires corn market, both cash and futures, upon Chicago corn prices.
- (2) *Danube countries position as producers of corn and other feed grains.*
- (3) *Mexico.*
- (4) *Competitive position of domestically produced glucose, starch (corn) and sugar in foreign markets.*
- (5) *Position of American animal products, produced chiefly from corn, in foreign markets.*

One study in progress bears on this problem:

374. Competitive Position of American Lard in Foreign Markets.

**F. Public Policy Related to Corn Belt Agriculture.**

Not only is technical and economic information indispensable in determining suitable agricultural policy, but it is also essential that both technical and economic research in agriculture be planned so that the results thereof are of maximum value in policy making. It is highly important that the large fund of basic data and statistics available in the several sections bearing upon Corn Belt agriculture be employed. This, however, calls for considerable coordination and synthesis of materials around specific problems. The following two projects are directed toward this end.

363. Determination of a Desirable Cropping System and Livestock Program for Each Township of Iowa for the Purpose of Developing Land Utilization Policy for the State.

367. Effects of Corn-Hog Program on Iowa Farming Organization and Management.

**G. Corn Statistics.** Special effort should be made to develop and collect statistical series pertaining to the following phases of corn:

1. *Production.*
2. *Prices.*
3. *Disposition.*
4. *Foreign Trade.*
5. *Corn Yields and Weather;* of special interest is the relationship of yields and weather and the extent to which it is possible to forecast probable yields of corn. Mr. Reed's office in Des Moines has available the most complete data on weather in the Corn Belt. These data, along with the available production figures offer unusual research possibilities. It seems probable that if these data were studied they would throw much light upon the relationship of both rainfall and temperature to plant growth. It is possible much more might be learned about the interaction of the growth factors and that these combinations in turn, in all probability, will be of some value in forecasting, within certain ranges, the yields of corn.



## 11. Corn History, Literature and Bibliography

The Institute should sponsor in cooperation with its librarian the development and publication of indexes to the literature of corn and possibly an annual summary of the world progress in corn research. The library and card indexes to the corn literature should be strengthened. Specifically the following types of projects seem to be desirable:

- A. **Compilation and publication of an annotated list of all important bibliographies that relate to corn.** Several rather general and many special lists of titles have been published.
- B. **Checking and Publication of Complete Card Catalog of U. S. D. A. on Corn.** The exact status of this card index should be determined, and provision made for publication, probably serially, of classified lists of titles. This should be brought down to date. It should be continued as noted under 3.
- C. **Annual (Perhaps Quarterly) List of All Current Publications on Corn.** The literature on corn is not confined to any one class of publications. Part of it may be in engineering magazines, in farm periodicals, theses or scientific journals not always indexed in the Experiment Station Record. An annotated publication issued monthly or quarterly which would bring this material together would seem desirable.

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