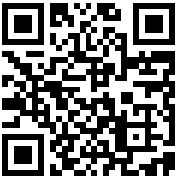

Classification of *Triticum*

Species and of Wheat Varieties Grown in the United States

Technical Bulletin 1278

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

Classification of *Triticum* Species and of Wheat Varieties Grown in the United States

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The writers are indebted to many agronomists and pathologists throughout the United States for assistance in providing information on history and reaction to diseases.

This bulletin is an extension of the classification of American wheat varieties initiated by C. R. Ball, J. A. Clark, J. H. Martin, and B. B. Bayles, all of the U.S. Department of Agriculture. The authors gratefully acknowledge their contribution to the procedure of conducting the studies and to the general style of presentation.

Some Russian papers cited were translated by Mrs. Tamara Sorokin, and some French and Spanish papers by Mrs. R. O. Hughes, both of Beltsville, Md.

CONTENTS

Classification of *Triticum* Species and of Wheat Varieties Grown in the United States

By L. W. Briggle and L. P. Reitz, *research agronomists*, *Crops Research Division, Agricultural Research Service*

Varieties of wheat grown commercially in the United States belong to only three species or subspecies—*Triticum aestivum* L. em. Thell. ssp. *vulgare* (Vill., Host) Mac Key, *T. aestivum* spp. *compactum* (Host) Mac Key, and *T. durum* Desf. Nevertheless, they show innumerable varietal differences. Many climatic and soil conditions prevail in the 41 States where wheat is grown commercially, and also in the 9 remaining States where it is grown to a limited extent. Varieties differ in their response to environmental conditions; some are adapted for growing over a large area and others are restricted to local conditions. Varieties differ in capacity to yield, in disease resistance, in milling and baking quality, and in morphologic characters.

Varieties are designated by popular names that rarely have any reference to distinguishable morphologic characters. Inability to identify varieties can lead to fraudulent or unknowing exploitation of old varieties under new names. Confusion in names was prevalent in years past when the same name was occasionally applied to different varieties in separate parts of the country, or the same variety was known by two or more names in one locality. Within the past decade many older varieties have gone out of commercial production. Few presently grown wheats are known by more than one name. Use of synonyms has virtually disappeared. Although farmers reported 212 distinct varieties grown in 1959 (*91*),[1] they had little difficulty reporting varietal designation. Some degree of confusion, however, was evident in reporting improved forms of a variety. Such groups as Baart, Baart 38, and Baart 46, Ramona, Ramona 44, and Ramona 50 are examples. The number designates the year in which the modified form was released (in most instances there is no difference from the original form except for disease or insect resistance). A number of farmers reporting such varieties did not know which Baart or which Ramona they had.

Choice of varieties is important to the wheat grower. Characters such as yield and quality of the grain, though of primary concern, cannot be used in identification. They are highly influenced by environment and are not easily measured. The grain buyer or processor is interested in varietal identification so that specific quality requirements may be met. There is need for a practical system of classification that will standardize the varietal nomenclature and facilitate identification of wheat varieties. One purpose of this bulletin

[1] Italic numbers in parentheses refer to Literature Cited, p. 119.

is to provide such a classification of (1) wheat varieties grown commercially in the United States in 1959, and (2) varieties not previously described that have been released since publication of "Classification of Wheat Varieties Grown in the United States, 1949" (*10*). A number of the latter group are recent releases that show potential of becoming commercially important.

PREVIOUS VARIETAL CLASSIFICATIONS

The U.S. Department of Agriculture started work on classification of wheat varieties grown in the United States in 1915. The original intent was to prepare a classification of the wheats of the world. During the first 2 years much time was devoted to study of foreign varieties, and several hundred introductions were added to the large collection of foreign wheats previously obtained. In the third year the study was devoted largely to diverse botanical types obtained from hybrids or distinct types found as mixtures in wheatfields in the western part of the United States. It was soon found, however, that if the studies were to be of economic value they must be limited to the principal cultivated varieties. All available domestic varieties were first grown in classification nurseries, where they were studied, described, and classified, and herbarium specimens were prepared and preserved in a classified order. New varieties were added from time to time as they became known, and each year varieties studied during the preceding season, together with the new ones, were grown to allow comparisons. By this means the classification became more complete each year.

Clark, Martin, and Ball in 1922 (*27*) presented descriptions, histories, distributions, and synonyms of 230 varieties grown up to 1919. Clark and Bayles in 1935 (*22*) included 77 new varieties and omitted 68 of the 230 varieties no longer grown commercially in the United States, thus describing a total of 239 varieties. Clark and Bayles in 1942 (*23*) added 50 new varieties and omitted 74, thus discussing a total of 215 varieties. Bayles and Clark in 1954 (*10*) included 81 new varieties and deleted 72. They covered 224 varieties in the last bulletin of the series. In this bulletin, 77 new varieties are added and 193 are omitted. Only those previously described varieties which were grown on 2 percent or more of the class acreage in 1959 (*91*) are repeated in the present work; the others have been dropped.[2] A grand total of 438 wheat varieties were classified and included in the classification bulletins published between 1922 and 1954.

A review of the literature pertinent to the classification of wheat varieties was given by Bayles and Clark (*10*), and before that by Clark and Bayles (*22*, *23*), and Clark, Martin, and Ball (*27*). It does not seem appropriate to repeat that review in this bulletin. Additional papers since published, which involve varietal classifications, are cited.

Erroux in 1954 (*41*) classified and described cultivated varieties

[2] Wheat varieties grown in the United States are divided into the following classes: (1) hard red winter, (2) hard red spring, (3) soft red winter, (4) durum, and (5) white. For example, if a durum variety previously described was grown on 2 percent or more of the total durum acreage in the United States in 1959, it was included in this bulletin.

(all *Triticum vulgare* Host.) that were grown in different oases of the Fezzan, in North Africa.

A key to the classification of wheat varieties in Belgium was published by Larose and others in 1956 (*72*). Complete descriptions included detailed characters of the spike and grain, and information on vegetative and physiological characters. An addendum by N. Noulard described additional varieties more recently obtained.

Fraser and Whiteside in 1956 (*47*) classified and described the spring wheat varieties of Canada and included origin, milling and baking quality, status, and distribution. This was one of a series of classification publications, the first of which was published in 1936 (*86*).

The Extension Services of Colorado, Kansas, Nebraska, Oklahoma, and Texas in 1956 (*40*) published a circular which listed spike, outer glume, and kernel characteristics of varieties that were commercially important in the hard red winter wheat area of the United States.

The Northwest Crop Improvement Association, Minneapolis, Minn., prepared a dictionary of spring wheat varieties in 1957 (*90*). A brief history and description were given for each variety listed, together with varietal recommendations of State experiment stations, market values in relation to varieties, and stem rust and leaf rust reactions of varieties grown. The dictionary included hard red spring and durum wheats grown in Minnesota, Montana, North Dakota, and South Dakota. This publication is one of a series dating back to 1933.

Sanchez-Monge in 1957 (*98*) classified and described the wheats of Spain. A key to the species of *Triticum* was given, as was a key to the varieties of Spanish wheats. Varietal descriptions included cold resistance, disease reaction, morphologic characters, adaptation, number of grains per spike, weight of 1,000 kernels, maturity, and other characteristics.

A historic review and classification and description of the wheat varieties of New Zealand was published by McEwan in 1959 (*77*). Listed in each description were: origin, general characteristics, juvenile habit, adult habit, spike and grain characteristics, disease reaction, yield, milling quality, and baking quality.

Da Costa Sacco in 1960 (*36*) listed the principal wheat varieties in South Brazil. He presented a key for varietal identification and described each variety according to characters of the green plant (growth habit, leaf cover—glabrous or pubescent, waxiness, maturity, rust resistance), and characters of the mature plant (height, stem diameter, thickness of stem walls, etc., spike, glumes, and grains).

Owen and Conacher in 1960 (*87*) prepared a guide for identification of wheat grain samples grown in western Canada. Wheat varieties are difficult to identify by kernel characters only. Characters that can be used are color, texture, size, and shape of the kernels; characteristics of the germ end and brush; and shape of the crease with the related shape of the cheeks of the kernel. Some varieties have distinctive features and can readily be identified, but it is essentially impossible to positively identify every kernel in a sample. Owen and Conacher state:

> Identification in many cases is made more difficult by three related factors: firstly, individual characters vary in degree within different samples of the same variety; secondly, ranges of variation in certain characters frequently overlap in different varieties, particularly when they are closely related; thirdly, climatic conditions during growth and harvesting may change some of the

characters and therefore only normal, well developed kernels should be examined.

Miller, Schaller, and Berryman in 1961 (*84*) presented a key for the identification of wheat varieties grown in California. Information on varietal origin, description, pest reaction, market use, and adaptation was listed.

CLASSIFICATION NURSERIES

The classification nurseries were grown in widely separated areas of the United States. This was necessary to determine the development of varietal characteristics under different environments and thus provide a classification that would be practical wherever the varieties might be grown. Nurseries grown from 1957 through 1960 furnished data for preparing this bulletin.

The entire Wheat Classification Nursery was sown in the fall and again in the spring of 1957, 1958, and 1959 at Aberdeen, Idaho, and at Stillwater, Okla. The spring sowing of an entry was in line with the fall sowing (one end of the row was fall sown and the opposite end spring sown). This procedure facilitated classification of an entry as a winter, intermediate, or spring wheat. Winter wheats sown in the spring failed to head (fig. 1). Field notes were taken on emergence, spring stand, growth habit,

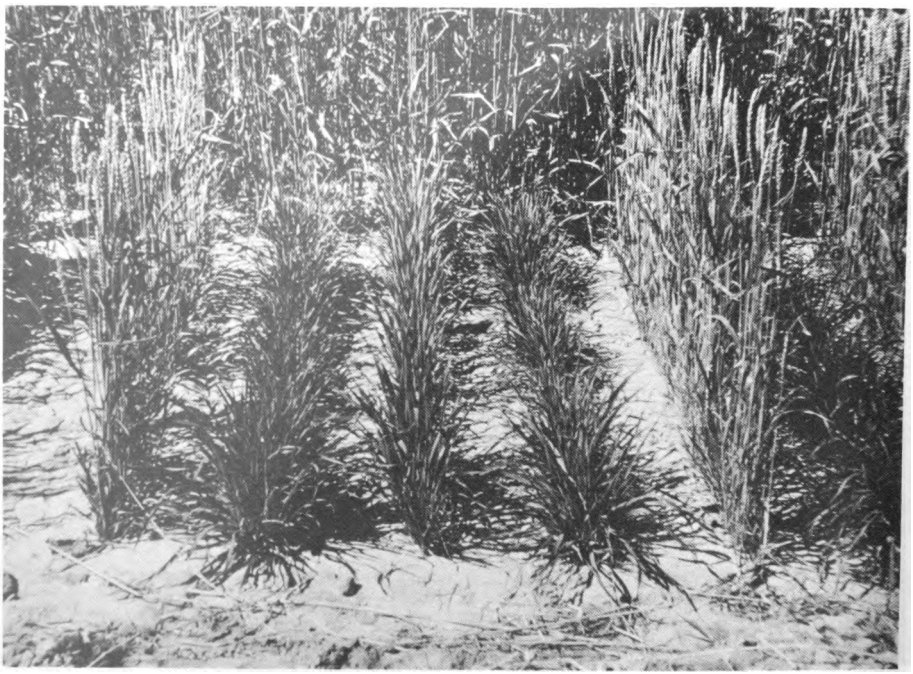

FIGURE 1.—Winter and spring wheats grown at Aberdeen, Idaho, and photographed in the summer. Outside rows are spring wheats, center three rows are winter wheats that did not head.

heading date, straw strength, straw color, position of spike (erect, inclined, or nodding), height of plants at maturity, and shattering. Representative heads were collected from each entry and observed for spike, glume, and kernel characteristics.

The entire nursery was grown in duplicate from fall sowings at Beltsville, Md., in 1958, 1959, and 1960. Heads were collected and data recorded from many of the entries. Spring entries were grown at Fargo and Minot, N. Dak., in 1959 and 1960 for evaluation of tendency to shatter. Winter entries were grown the same 2 years at Clovis, N. Mex., for the same purpose.

Nature of the Material

Early studies (*27*) showed the necessity of working with pure types. When bulk seed was used it often consisted of mixed varieties, and a wrong description might easily be applied to a variety. The same variety was often represented by different lots of seed obtained from different sources. These lots were identified by different C.I. numbers (accession numbers of the Cereal Crops Research Branch, Crops Research Division). Records show the source of seed and the original source of the variety. After different seed lots of the same variety had been grown for a few years, one was selected as the standard for the variety. The descriptions in this bulletin, therefore, should represent the true type of the variety. In certain varieties, however, material was limited to samples obtained from only one or two sources; the judgment of the writers in selecting the strain to represent these varieties may not have been so accurate as where more samples of the same variety were available.

Varieties on occasion become mixed when grown in commercial fields. This may account for differences observed between a variety as commonly grown and its description in this bulletin. In other cases, all the characters here recorded may not become apparent in some localities, and this may cause some confusion. The failure of stem and glume colors to develop in some sections is an example of this.

Natural crossing between wheat plants occurs quite commonly. The resulting hybrids have caused some difficulty in describing varieties, especially since hybridization between closely related varieties could not always be determined. Many recently released varieties are shorter than former commercial varieties. Most progenies from natural crossing between the two types are intermediate in height. Thus, hybrid plants are generally visible in a field of short wheat. Perhaps as many hybrid plants from natural crossing occurred in years past, but were not readily detected.

Nearly every field of wheat contains some plants that do not fit the standard description of that variety. Many of these are the result of natural crossing. Others may be mechanical mixtures, or are variants resulting from environment.

Every attempt was made to obtain pure seed of each variety described for growing in the Wheat Classification Nursery. Usually, breeders' seed was procured from the originator.

DESCRIPTION, HISTORY, AND DISTRIBUTION

Each variety is described in some detail. General history is given so far as known. Distribution of the variety in the United States is discussed and, where applicable, synonyms are listed.

DESCRIPTION

The detailed descriptions, which include the more important taxonomic characters, contain much more information than do the keys. The descriptions are intended to be sufficiently inclusive to provide a comprehensive knowledge of the different varieties.

Reaction of each variety to the important diseases of wheat follows the taxonomic description. *Reactions are based on field observations (in some cases supplemented by greenhouse or growth chamber tests) and are subject to change. Disease organisms in nature are highly unstable genetic populations. The possibility of a variety, heretofore resistant to a disease, being attacked by a new genetic variant of the parasite is ever present.*

Degree of winter hardiness is given for winter wheats, and an evaluation of shattering characteristics is listed where appropriate for either winter or spring types. Quality attributes are included under the description.

HISTORY

The history of the origin of varieties cannot be neglected in a classification, as many varieties are scarcely or not at all distinguishable by observable characters, from similar or closely related varieties, and differ only in their origin and other qualities. Much attention has been given to the history of varieties. Pedigree, breeding method, time the cross and the final selection were made (pertaining to varieties of hybrid origin), field testing procedure, information on release of the variety, and other details are given when available for each variety described.

Most varieties are developed through cooperative efforts of State experiment stations and the Agricultural Research Service, U.S. Department of Agriculture. This fact is noted in the history of individual varieties. Divisions within the Agricultural Research Service (Crops Research Division and Entomology Research Division) that have contributed are cited.

DISTRIBUTION

The commercial distribution, production, and grain quality of different varieties are the economic factors with which this classification is concerned. Varieties that are most widely grown usually are the most valuable. Varieties that are more productive may exist, but until they become known and widely grown they are of little value. New varieties are being produced continually. Most are improvements over the old standard varieties, as their use improves the quality or increases the efficiency of production.

The acreage and distribution of the commercial varieties of wheat in the United States have been determined by surveys conducted at

5-year intervals since 1919 by the U.S. Department of Agriculture (*24*, *28*, *30–33*, *91*, *97*). By means of these surveys a record of the increase of new varieties and the decrease of old varieties is made possible.

States in which each variety was grown in 1959 are listed in this bulletin following varietal history. Several varieties have been released so recently that they did not appear in commercial production at the time of the survey; therefore, no information on distribution is available.

The number of varieties reported grown in each survey year from 1919 through 1959 is as follows:

Year of survey	*Varieties (number)*
1919	139
1924	152
1929	190
1934	213
1939	208
1944	216
1949	199
1954	203
1959	212

In all, 434 distinct varieties have been reported in the 9 surveys. A few varieties have been grown (most on a limited acreage in recent years) over the entire 40-year period—for example, Leap, Blackhull, Turkey, Purplestraw, and Marquis (*91*).

VARIETAL NOMENCLATURE

A standardized nomenclature is important because names are used by agronomic workers, growers, seedsmen, and the grain trade. The form and appropriateness of these names, therefore, are of general interest. It is desirable that they be short, simple, and appropriate, easy to spell, and easy to pronounce. It also is desirable that a single name be accepted and used for each recognized variety.

The multiplication of names and other designations for crop varieties has sometimes been carried to extremes, resulting in great confusion. Some varietal designations are merely descriptive phrases that are often long and cumbersome. Others are only numbers, which sometimes are equally long and cumbersome or are easily confused. Because of this, a code of nomenclature was proposed by Ball and Clark and presented to the American Society of Agronomy at the annual business meeting in 1917. With a few minor changes, the code was adopted and published (*9*, *22*, *27*).

More recently the American Society of Agronomy has had representation on an International Commission for Nomenclature of Cultivated Plants, which was organized by the International Union of Biological Sciences. This Commission formulated a code, which was published in 1958. A corrected edition was published in 1961 (*60*). Extracts from the code which seem particularly pertinent to the naming of wheat varieties are quoted by article number:

> Article 5.—The term variety denotes an assemblage of cultivated individuals which is distinguished by any characters (morphological, physiological, cytological, chemical or others) significant for the purposes of agriculture, . . . and which, when reproduced, retains its distinguishing features.
>
> Article 12.—The practice of designating an improved selection of a variety as a strain or equivalent term is not adopted in this Code. Any such selection showing sufficient differences from the parent variety to render it worthy of a name is to be regarded as a distinct variety.
>
> Article 19.—A variety name must not be used for more than one variety within a genus or hybrid genus. . . .
>
> Article 20.—A new variety name should preferably consist of one or two words and must not con-

sist of more than three words. For the purposes of this Article a symbol, an abbreviation, or a numeral is counted as a word.

Article 21.—*Inadmissible Names.* New variety names published in the following form are inadmissible:

a. The botanical or common name of a genus or the common name of a species.
b. The names of varieties of hybrid origin formed by combining parts of the Latin epithets of the parent species . . . .
c. Names including the word "variety" (or "var.") or "form" . . . .
d. Translated personal names. Examples . . . "Jean Jacques" must not be altered to "John James".

Recommendation 21A

It is strongly recommended that, whenever possible, new variety names in the following form should be avoided:

a. Names containing numerals or symbols, except as established custom requires. Examples of crops where such names are admissible . . . wheat ("Baart 38").
b. Names containing an initial article, unless required by linguistic custom. Example: Not "The Colonel" but "Colonel" . . . .
c. Names beginning with abbreviations . . . .
d. Names consisting of, or containing, excessively long words or phrases . . . .
e. Names exaggerating the merits of a variety or which may become inaccurate through the introduction of new varieties . . . .
f. Names that are vaguely descriptive. . . .
g. Names likely to be confused with existing names within the same genus . . . .

Article 24.—In order to be valid, publication of a variety name is effected by the distribution to the public of printed or similarly duplicated matter.

Article 25.—*Dating of Publication.* For valid publication the printed or similarly duplicated matter containing the new variety name must be clearly dated at least as to year.

Article 26.—In order to be valid, the publication of a variety name on or after 1 January 1959 must be accompanied by a description or by a reference to a previously published description as a variety or in any botanical category . . . ; for names published before 1 January 1959, a description or a reference to a previously published description is not necessary.

Article 28.—The naming of varieties is based on priority of publication except when expressly limited.

Article 31.—*Exceptions to Priority.* When a variety name is generally used instead of an earlier legitimate name of the same variety, the former is retained as the correct name if the use of the latter would lead to confusion. Such action may be taken only with the approval of the registration authority concerned, if such exists.

Article 35.—The name of a variety must be rejected if published on or after 1 January 1959 without the permission of the originator of the variety or his assignee if such are known.

Article 36.—When a variety is introduced into another country, its original name is normally retained. However, when there are linguistic or other difficulties, such as translation or transliteration, a change of name is allowed.

Article 51.—*Registration* is the acceptance of a variety . . . by a registration authority and the inclusion of this name in a register.

Article 54.—For purposes of this Code, the *originator* is the person or agency producing the new variety. The *describer* is the person or agency first validly publishing a name. The *introducer* is the person or agency first making a variety available to the public.

Any person or persons responsible for assigning a name to a new United States wheat variety is urged to give careful consideration to the aforementioned Code and to clear the name as to prior use by contacting the Crops Research Division, ARS, USDA. Copies of the complete *International Code of Nomenclature for Cultivated Plants* are available through the American Horticultural Council. Dr. Donald Wyman, Arnold Arboretum, Jamaica Plain 30, Mass., is distributor for the United States.

REGISTERED VARIETIES

Registration of wheat varieties has been a joint function of the American Society of Agronomy and the Agricultural Research Service, U.S. Department of Agriculture, since 1926. In that year the official names and registration numbers for 229 wheat varieties were published (*25*), along with descriptions of each. A total of 402 registrations of standard and improved varieties has been published (*15*, *20*, *21*, *25*, *26*, *29*, *56*).

An official registration includes information on the origin of the variety, name of the breeder or introducer, literature citations concerning performance in comparison to a standard variety and on name assignment, superior characteristics of the variety, a description, testing procedure used, area of adaptation, and a statement indicating commercial utility.

In this bulletin, the registration number of each variety registered appears in parentheses with the C.I. number in the history section, for example: Bison (C.I. 12518; reg. 371), page 96.

SYNONYMY

A few currently grown varieties are known by more than one name. Names listed in this bulletin for the recognized varieties are the original names. All other names used for the described varieties are considered synonyms.

THE WHEAT PLANT

The different cultivated varieties of wheat vary greatly in their habit, form, and structure, but all are annual grasses. The principal parts are the roots, culms, leaves, and spikes. There are two sets of roots—the first, or seminal or seed, roots; and the second, or coronal, roots which arise from the crown of the stem. The culm usually is a hollow, jointed cylinder comprising three to six nodes and internodes. The upper internode of the culm, which bears the spike, is called the peduncle. The leaves are composed of the sheath, blade, ligule, and auricle. The spike (fig. 2) is made up of the rachis and spikelets, the latter in turn comprising the rachillas, glumes, lemmas, paleas, and the sexual organs (the three stamens and the single ovary with its style and stigma). Figure 3 is a photograph of an exposed wheat flower.

Each part of the wheat plant may show distinct characters in different varieties. Those characters that do not vary in different varieties or are not readily observed are of little value in classification. The root characters, for example, cannot be conveniently used, and no attention has been given to them in these studies. Other characters, such as those of the sheaths, ligules, and auricles, are not generally used because they show very slight differences in different varieties.

The keys and descriptions used here to identify varieties are based on characters that show constant differences and are therefore of value in identification.

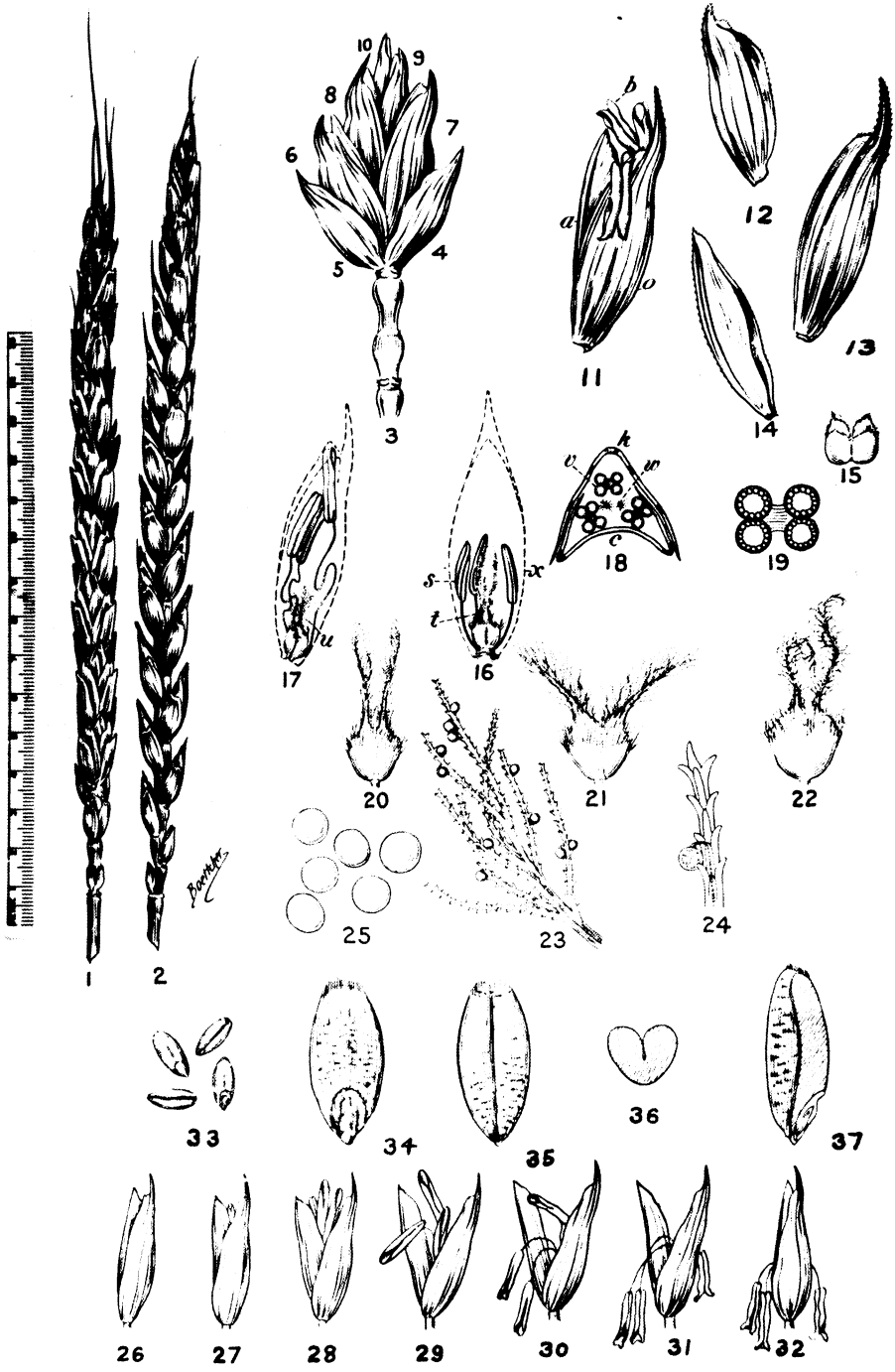

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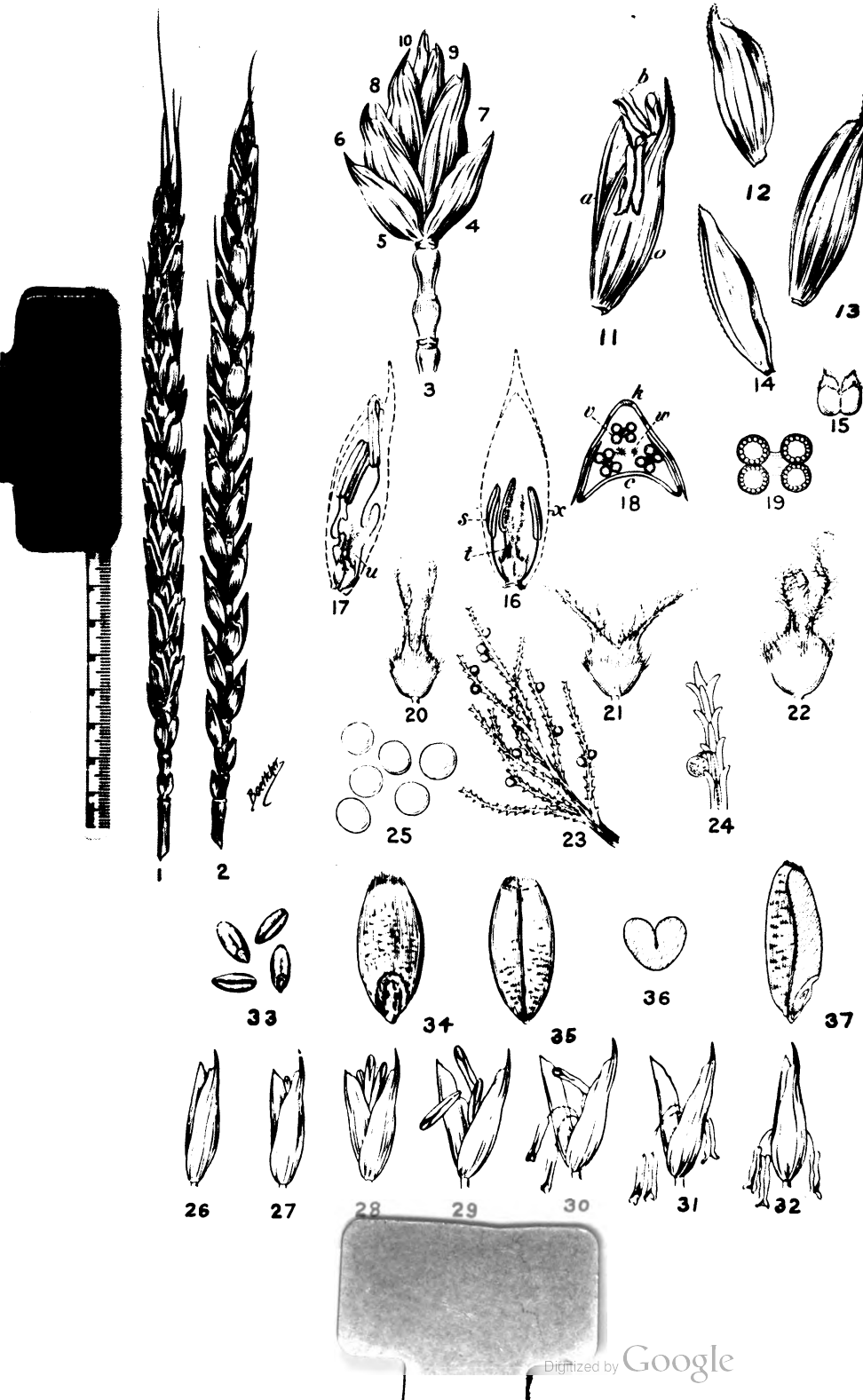
FIGURE 2.—The wheat inflorescence. 1. Spike dorso-ventral view. 2. Spike, lateral view. 3. Spikelet, lateral view and subtending rachis. 4. Upper glume. 5. Lower glume. 6, 7, 8, 9 and 10. Florets. No. 6 and No. 7 are largest, while Nos. 8, 9 and 10 are progressively smaller. 11. Floret, lateral view, opening in anthesis. 12. Glume, lateral view. 13. Lemma, lateral view. 14. Palea, lateral view. 15. Lodicules, which swell to open the glumes. 16. Floret before anthesis, showing positions of stamens (*s*) and pistil (*t*). 17. Floret at anthesis, showing position of pistil (*u*) and the elongating filaments of the stamens. 18. Cross section of floret; (*c*) palea, (*k*) lemma, (*v*) stamen, and (*w*) stigma. 19. Cross section of anther. 20. Pistil before anthesis. 21. Pistil at anthesis. 22. Pistil after fertilization. 23. Portion of stigma (greatly enlarged) showing adhering pollen grains. 24. Tip of stigma hair (greatly enlarged) penetrated by germinating pollen grain. 25. Pollen grains, enormously enlarged. 26 to 32. Florets during successive stages of blooming and anthesis. Time required for stages 26 to 31 is about 2 to 5 minutes, for stages 26 to 32 about 15 to 40 minutes. 33. Kernels (Caryopses). 34. Kernel, dorsal view. 35. Kernel, ventral view. 36. Kernel, cross section. 37. Lateral view, with one-half the kernel in longitudinal section. (34 through 37, greatly enlarged).

FIGURE 3.—Portion of spike of common wheat showing interior of one floret at center, enlarged about 3½ times.



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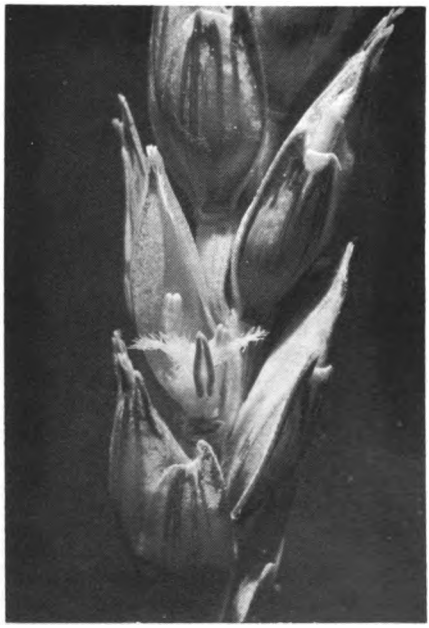

FIGURE 3.—Portion of spike of common wheat showing interior of one floret at center, enlarged about 3½ times.

TAXONOMIC CHARACTERS

Taxonomic characters of the wheat plant that have been found to be most useful are described in detail. The characters used to distinguish the different species, subspecies, and lesser groups in the genus *Triticum* are often of no higher rank than the characters used to distinguish the cultivated varieties.

In the keys, certain primary characters are used in a regular sequence. Certain other characters are used to separate further the closely related varieties. For this purpose any character is used that serves to distinguish the varieties under discussion. The same characters are not necessarily used in two successive varieties, and they are not used in any definite order. The general principle followed in the choice of characters is to progress from those most easily observed and most often occurring to those least easily observed or least often occurring. The principle governing the sequence of characters is to progress from the absence of the character, as awnlessness, to the presence of the character, and from the smaller size to the greater.

The descriptions of the wheat varieties are arranged in a logical order of plant development. The major and minor characters used in the key are included in their proper places in the descriptions, as are many minor characters not used in the keys.

All the characters used in the keys and the descriptions of cultivated varieties are considered in the following paragraphs in the order of their appearance in the descriptions.

PLANT CHARACTERS

Certain plant characters that are genetically different in the several varieties are of value for classification purposes. These are the habit of growth, the period of growth, and the height of the plant.

Habit of Growth

All wheat varieties are here classified as having winter habit, intermediate habit, or spring habit of growth. In the keys to the cultivated varieties this character occupies the sixth and last major position.

Varro (as cited by Columella *34*), writing before the beginning of the Christian era, called the spring wheats *trimestrian*, because they matured in 3 months from sowing. Linnaeus (*74*) treated them as separate species in his Species Plantarum, but combined the awned factor with the spring habit in his species *aestivum* and the winter habit with the awnless factor in his species *hybernum*. Few agronomic writers have recognized these forms as distinct species. The existence of winter and spring forms has been recognized by most authors but recently has not been used as a character for separating species or even as an important character for separating varieties.

When considering the United States as a whole, we regard these distinctions as less valuable for classification purposes than several spike and kernel characters, although the winter- or spring-growth habit is a very important separation in some areas. In the southern part of the United States, both east and west, several varieties of spring wheat are fall-sown, and growers do not know whether they have a spring wheat or a winter wheat. The Purplestraw variety of the Southeastern States has a spring-intermediate habit, although it has been grown from fall sowing in that section for more than 150 years. Nearly all the varieties

grown in Arizona and California are spring wheats, but they are fall-sown.

Winter, intermediate, and spring habits of growth are inherited characters. They are the characters shown first in the descriptions, as they are first apparent in the growth of the plant. In the keys the wheats having a winter habit are listed before those having a spring habit, because there are more winter wheats than spring wheats and because winter wheat is of much greater economic importance in this country than spring wheat.

The intermediate types retain a prostrate habit of growth in most localities when sown late in the spring, but will head normally when sown early. Some early maturing winter wheat varieties also have a short prostrate, or dormant, period and, when sown in early spring, begin heading soon after intermediate wheats have headed. Also, certain varieties of wheat grown commercially are mixtures with respect to growth habit. The different classes for growth habit are not clear cut, as there is a more or less complete series of types from true winter to spring and their expression depends on temperature, length of day, and date of seeding. However, for the varieties reported in this bulletin the differences have been carefully determined by sowing varieties on one or more dates in the spring and observing their behavior. Varieties classified as winter wheats do not produce seed when sown at normal dates for spring seeding.

Winter wheats can be produced successfully in the principal wheat areas of this country only from fall sowing. When spring-sown they usually remain prostrate on the ground throughout the growing season and produce no culms or spikes. In some sections or in some years, winter-wheat varieties, sown very early in the spring, will head and produce seed, but heading is often irregular and usually occurs very late in the season.

All varieties classified as spring wheat can be grown successfully from fall sowing only in mild climates, such as the southern parts of the United States and in some areas of the Pacific Coast States. In parts of this territory they sometimes winterkill. When spring-sown their early growth usually is erect.

Time of Heading and Ripening

The relative dates on which varieties head and ripen when sown at the normal time in regions where they are adapted are useful in identifying varieties. The heading date ordinarily is more useful than the ripening date. The relative order of maturity is indicated by classifying varieties as early, midseason, or late (some are intermediate between these classes). The relative time of heading and ripening is somewhat dependent on time of seeding and also varies somewhat in different areas. More than usual caution, therefore, must be exercised in making use of these characters.

Height

The height of the plant is often important in wheat production, because it may determine the method or ease of harvesting and the susceptibility of varieties to lodging. Height is measured from the surface of the ground to the tip of the spike, not including the awns of awned varieties. All varieties of wheat have been placed in three classes—short, midtall, and tall, or are considered intermediate between these classes. These are characters of minor value for classification and are used only for separating or distinguishing otherwise closely related varieties.

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Since plant height influences susceptibility to lodging, several new varieties bred for resistance to lodging have short stems. Although there was formerly a widely held opinion that tall plants were essential for high yields in wheat, varieties with short stiff straw that outyield the taller varieties have been developed recently in several sections of the country. Examples are Gaines, a "semidwarf" common soft white wheat; Monon, a short soft red winter wheat; and Georgia 1123, a short to midtall soft red winter wheat.

The principles governing the grouping of varieties as early, midseason, and late apply here also. As an example, under California conditions wheats from 12 to 36 inches in height would be classed as short; from 24 to 48 inches, midtall; and from 36 to 60 inches, tall. In many sections of the country these differences would not be so great. In order to use the height of the plant for classification, the height of certain varieties must be determined and used for comparison. There are also cases where the relative height is changed when the varieties are grown in different sections of the country; for example, some of the club wheats are usually short when grown east of the Rocky Mountains but relatively tall when grown west of these mountains.

STEM CHARACTERS

Three characters of the stem of wheat varieties are useful in classification; namely, color, strength, and degree of hollowness.

Color

All varieties of wheat are here classified as having white or purple stems. These characters are of minor importance in classification, for in many localities and in some seasons the purple color common to a large number of wheat varieties does not become apparent. This is often the case under conditions of either extreme drought or excessive moisture. Under favorable conditions, however, this stem color may be clearly seen for a week or 10 days prior to maturity. When apparent, the color differences are very useful in distinguishing varieties. The color is usually most distinct on the peduncle, or uppermost internode supporting the spikes, but often continues downward to the sheaths of the lower leaves.

Varieties here described as having white stems may have a stem color ranging from a cream to a golden yellow. Few, if any, have stems that are truly white.

Varieties classed as having purple stems may have a stem ranging in color from a pale violet to a dark purple. In some varieties this coloring may occur only in a short portion of the peduncle. It sometimes does not occur in the peduncle and is present only in the sheaths.

Strength

Strength of stem usually is an important character. In many localities lodging is one of the most serious problems in wheat production, particularly under conditions of excessive moisture. All varieties here discussed are classified into three groups, having weak, midstrong, or strong stems, respectively, or, in some cases, a combination of two classes is used (midstrong–strong). Stems classed as weak are also usually slender, with very thin walls. Varieties with weak stems have a greater tendency to lodge, which in turn causes harvest losses and increases the cost of harvesting. The successful cultivation of weak-stemmed varieties usually is limited to semiarid or arid regions.

Varieties classed as having midstrong stems usually will not lodge under conditions where wheat is

grown extensively. In this class are included the greatest number of varieties. A considerable variation exists within this group, and in humid or irrigated sections varieties here described as having mid-strong stems might more properly be classed as weak. In dry-farming sections certain of these stems might more properly be classed as strong.

Varieties here described as having strong stems are those that will not lodge readily under excessively humid conditions. Only by severe rain, by hail, or by windstorm can the stems of these varieties be bent or broken down. Comparatively few of the cultivated wheats are in this class. A few examples are Lemhi 53, a common soft white spring wheat; Burt, a common hard white winter wheat; Lakota and Wells, amber durums; and Redcoat, a soft red winter wheat.

Hollowness

The stems of most varieties of wheat are solid at the nodes, but the internodes are hollow. Some varieties of durum and poulard wheat and a very few varieties of common wheat have stems that are solid or nearly so in the internodes. In some varieties solidness is associated with resistance to the wheat stem sawfly.

LEAF CHARACTERS

The principal parts of the leaves of wheat plants are the sheath, blade, ligule, and auricle. None of these parts usually show differences that are of even minor value for distinguishing cultivated varieties.

The blades of wheat varieties vary considerably in their dimensions, in the shade of green, and in the angle to the culm maintained during the successive periods of growth. These differences, however, are usually apparent during only a short period. As the plant matures, the blades dry and frequently break off. In this bulletin very little use is made of leaf characters.

The presence or absence of pubescence on the leaves is a useful character in identifying plants of a few varieties.

Few persons can agree as to the various shades of green shown by the blades of wheat, even when a standard color chart is used. The color varies with the condition of the plant as affected by the temperature, the soil moisture, and the soil solution. The color is changed by the character of the venation and of the blade surface. The plants appear to have a different color in the sunlight from that in the shade, and the value changes also according to the position of the observer with regard to the direction of the rays of the sun. In general, the hard red winter wheats have dark-green blades, whereas the durum varieties have blades that are light green.

The hard red winter wheats are distinctly narrow leaved, and some soft varieties like Alba (Redmond) have wide leaf blades. Winter varieties having the narrowest blades usually are most resistant to low temperatures. Length of the leaf blade is not a stable characteristic.

The terminal leaf or flag leaf of some varieties of wheat is erect and in others it is drooping at various angles. These differences are greatest just previous to the heading period but frequently are not apparent a few days later. Chiefly because of the instability of this character, it is not used in this classification. In some varieties like White Federation 54 the flag leaf is curled or twisted, whereas in most varieties it is flat.

The sheaths normally enclose about the lower two-thirds of the

culm, although in dry seasons the spike sometimes is not entirely exserted. The edges of the sheath overlap on the side opposite the blade. The sheaths may be either white or purple. During early growth they usually are quite scabrous, but they become smoother at maturity. There are some differences in these characters in the cultivated varieties, but they are few and minute.

Differences observed in the ligules and auricles are likewise insignificant. The ligules usually are short, varying from 1 to 2 mm. in length and becoming lacerate as the plant matures. Auricles are narrow to midwide, usually strongly curved, with a few long strigose hairs on the outer margin. The auricles often are purple in the young stage, sometimes changing to white as the plant matures.

SPIKE CHARACTERS

The entire inflorescence on one culm is called the spike. It is made up of separate groups of flowers known as "spikelets." These are borne singly on alternate sides of a zigzag, flattened, channeled, jointed rachis, parallel to its flat surface (fig. 2). At the base of each spikelet, on the apex of each rachis joint, a tuft of short hairs usually occurs. These hairs may be white or brown, but the differences are difficult to distinguish, partly because the hairs frequently are discolored.

Spikes differ greatly in form and degree of compactness. Club wheats (*Triticum aestivum* ssp. *compactum*) have been separated from common wheats (*T. aestivum* ssp. *vulgare*) principally because of their distinctly dense spikes.

In distinguishing the cultivated varieties, five spike characters are used. These are awnedness, shape, density, position, and shattering of the spikes.

Awnedness

Awns are sometimes important agriculturally and are usually the character most readily apparent. For these reasons awnedness is given precedence over all others in preparing the keys.

Varieties are separated into two major groups on the basis of the awnedness character, namely, awnless to awnleted, and awned. As a minor character in the key and in the descriptions the awnless to awnleted group is subdivided into awnless, apically awnleted, and awnleted. The awn types are shown in figure 4, *A*. Awnless varieties have no awnlets or very short apical awnlets. Apically awnleted varieties have short awnlets 1 to 15 mm. long at the apex of the spike. Awnleted varieties have awnlets 3 to 40 mm. long, the shorter ones occurring near the base of the spike and the length increasing toward the apex.

Awned varieties have an awn or beard that terminates the lemmas on all spikelets. These awns usually increase in length from the basal part of the spike upward. In the common wheats, awns seldom, if ever, exceed 10 cm. in length. In durum and poulard wheats, however, they usually range from 10 to 20 cm.

Shape

Spikes differ greatly in shape, length, and width. They may be flattened parallel or at right angles to the plane of the face of the spikelets. Those flattened parallel to this plane are widest when seen in face view and can be said to be dorsoventrally compressed. The spikes of all varieties of common wheat are thus formed, except those that are clubbed at the tip, in which case they are only partly so. Spikes that are flattened at right angles to the plane of the face of the spikelets are narrow when seen in face view and may

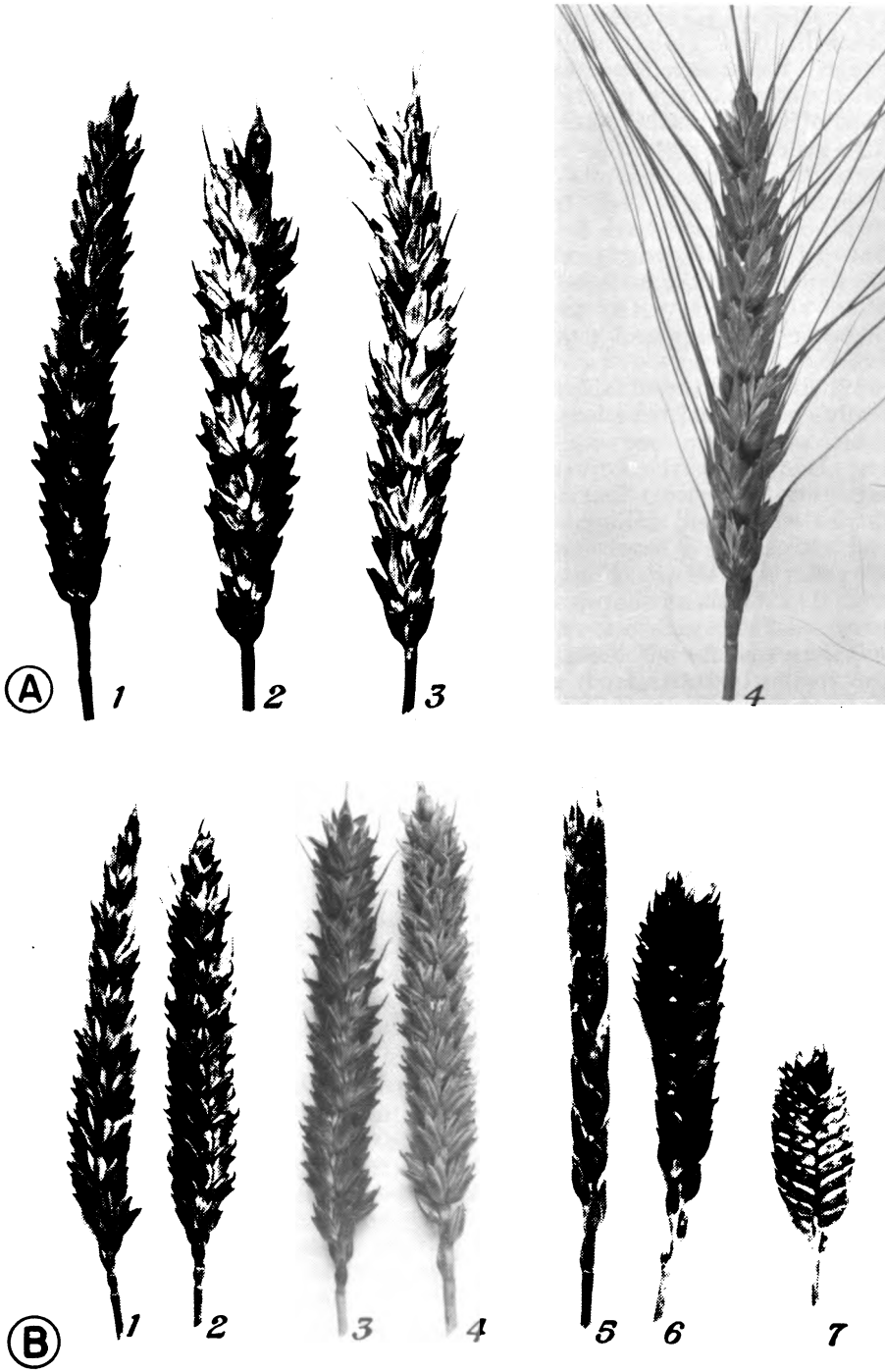

FIGURE 4.—Wheat varieties: *A*, Awn types—(1) awnless, (2) apically awnleted, (3) awnleted, and (4) awned; *B*, Spike shapes—(1 and 2) fusiform, (3 and 4) oblong, (5 and 6) clavate, and (7) elliptical.

be described as laterally compressed. The club, durum, and poulard wheats are separated from the common wheats partly on the basis of having such spikes.

In general, spikes range in length from 5 to 15 cm., but are usually 8 to 12 cm. long. They range in width or thickness from 1 to 3 cm. The differences in length and width are not used in themselves, but are often combined with the spike shape in a compound descriptive word.

Whether dorsoventrally or laterally compressed, whether long or short, or narrow or wide, spikes are classified in the keys as having the following four general shapes—fusiform, oblong, clavate, and elliptical. These shapes are shown in figure 4, *B*. For all common wheats these shapes are determined from a face view of the spikelets and for all club, durum, and poulard wheats from an edge view of the spikelets. The shapes mentioned, however, are here considered only as minor characters; nevertheless, they are very useful in distinguishing varieties.

Spikes classed as fusiform taper toward the apex or from the middle toward both base and apex. A majority of the varieties of common wheat have spikes of this shape.

Spikes described as oblong are usually uniform in width and thickness throughout the length of the spike but are always several times longer than wide.

Varieties classed as having clavate spikes are distinctly larger and more dense at the apex. This is caused by a shortening of the rachis internodes in that part of the spike, which results in a change from dorsoventral to lateral flattening and a broadening of the upper part of the spike.

Elliptical spikes are short and uniformly rounded at both the base and apex but are flattened on the sides. Most varieties of club wheat have spikes of this shape.

In the descriptions of varieties these designations of spike shapes have sometimes been modified to take into account not only the length and width of the spikes but also the overlapping of shapes that occurs in some varieties.

Varieties that are nearly intermediate between any of the shapes are sometimes described as oblong to fusiform or fusiform to oblong.

Density

The differences in shape of spikes (fig. 4, *B*) are the result in part of differences in density. All spikes are described as being in one of three density classes—lax, middense, and dense. These are minor differences that are used to advantage in distinguishing varieties.

Degrees of density have been utilized by many taxonomists to describe varieties or groups of varieties of wheat.

Many measurements were made by Bayles and Clark (*10*) to determine difference in density of spikes. The most definite differences were found comparable at one station for 1 year, but otherwise these measurements were of little value. It was necessary to establish density classes of rather indefinite limits. In this way allowance was made for the varying conditions. The density classes were fixed as lax, middense, and dense by determining the number of millimeters occupied by 10 internodes of the rachis measured in the center of the spikes. By this method spikes are classed as lax when 10 internodes occupy from 50 to 75 mm., as middense when 10 internodes occupy from 35 to 60 mm., and as dense when 10 internodes occupy from 20 to 45 mm. A majority of the varieties are included in the middense class, which, according to the above measurements, overlaps both the

dense and lax classes by two-fifths of their entire range.

Position

The position of the spike at maturity is often distinctly different in different varieties. Spikes are here described as erect, inclined, or nodding.

Varieties described as having erect spikes mature with the spike in an approximately vertical position. The spikes of these varieties seldom, if ever, are inclined more than 15° from the vertical at maturity.

Spikes of varieties described as inclined usually mature at an angle of approximately 15° to 45° from the vertical, but sometimes are nearly erect and under some conditions will become slightly nodding. A majority of the wheat varieties are within this class.

Varieties described as having nodding spikes usually mature with the spike in a drooping position, the apex of the spike being lower than the base. Spikes of such varieties sometimes are inclined only if they are not well filled with grain when ripe.

Shattering

Glumes of different varieties vary in the tenacity or firmness of attachment to the rachis, in the tightness with which they clasp the kernels, and in size in relation to size of the kernels. These and possibly other characters cause varieties to differ greatly in their resistance to shattering. The durum varieties usually do not shatter easily. Most commercial varieties of common and club wheat are resistant, but some varieties are subject to loss of grain by shattering if allowed to stand in the field to full maturity. Such varieties are not adapted for harvesting with the combine. This character is usually mentioned only for the varieties that tend to shatter.

GLUME CHARACTERS

The unit of the spike is the spikelet (fig. 2). It consists of several flowers or florets attached alternately to opposite sides of a central axis or rachilla. These flowers, two to five in number, are subtended by two empty scales called the glumes, the keel of each glume terminating in a tooth or beak. Each floret consists of a flowering glume called the lemma, and a thin two-keeled glume called the palea. These two glumes enclose the sexual organs. The lemma encloses the back, dorsal, or outer portion of the mature kernel, and in the awned varieties it terminates in an awn. The lemma itself is of little use in variety classification. The palea protects the inner or crease side of the kernel. It differs from the lemma in having its back instead of its face toward the rachilla or axis of the spikelet. Like the lemma, it is not used in distinguishing varieties. The outer glumes, however, are very useful in identification. *Determinations of glume characteristics were confined to the central one-third of a spike which was examined.*

Color of the glumes is a major characteristic and is used in the second place in the key. Length and width of the glumes are used but are of only minor importance. All varieties described are glabrous, so glume covering is not found in the key. A few pubescent varieties were included by Bayles and Clark (*10*), and glume covering was used in the earlier classification bulletins as a major character in separating varieties because of the striking contrast between absence and presence.

Color

Differences in glume color were early recognized. Lamarck (*71*) used these distinctions in classifying varieties. All glumes are

classed as white, yellow, or brown, but may have black markings.

Glumes classed as white may range in color from a cream or pale-straw color to a dark yellow. Practically no glumes are without color. Within the class, however, there are two rather distinct shades. Some taxonomists have classified them separately as white and yellowish. In this bulletin, however, both shades are placed in the same class and described only by the term "white" except for the durums, which are classed separately as white and yellow. In the descriptions the glumes of some varieties of common wheat are described as being yellowish white, indicating a darker glume than those described as white. A few varieties have white or yellowish glumes with brown or black stripes or nerves, or the glumes are sometimes tinged on the edges with brown or black. Such varieties are placed in the white-glumed class and the peculiar markings are indicated in the descriptions and in some instances in the key. The hard red winter varieties Wichita, Crockett, and Bison have white glumes with distinct black markings. KanKing, another hard red winter variety, differs from them in having brown glumes with black markings.

Glumes of durum varieties classed as yellow are much darker than those of the common wheats classed as white but similar to those described as yellowish white. This yellow class, therefore, is quite distinct. It may range in color from yellow to buff.

The brown-glumed class usually is still darker than the yellow class and may vary in shade from light to dark brown and bluish brown, and in some varieties there is a reddish or mahogany tinge. For the latter reason some taxonomists have used the term "red," but "brown" more accurately describes the glume color of the class as a whole.

No commercial varieties grown in the United States have glumes that are entirely black.

Length

Glume length is used as a minor character in the varietal descriptions. Usually small-kerneled varieties have short glumes and large-kerneled varieties long glumes, but there are exceptions to this. The glumes are usually about three-fourths the length of the lemmas, although in some long-glumed varieties the glumes and lemmas more nearly approach the same length. Polish wheat (*Triticum polonicum*) has glumes as long as or longer than the lemmas and is separated from the other species principally on this distinction. The length of the glume is here described as short, midlong, or long (fig. 5). Most varieties of wheat have midlong glumes. A few varieties, however, are distinct in having either short or long glumes. Short glumes range in length from 6.5 to 7.5 mm. Midlong glumes may range from 7.0 to 8.5 mm., and long glumes from 8.0 to 11 mm. The glumes of Polish wheat exceed this latter

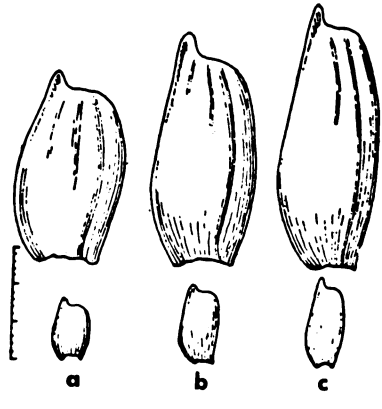

FIGURE 5.—Glume length: *a*, Short; *b*, midlong; *c*, long. (Upper row, × 3; lower row, × 1.)

measurement and are described as very long.

Width

The width of glumes is used in the same manner as the length. All glumes are described as being narrow, midwide, or wide (fig. 6).

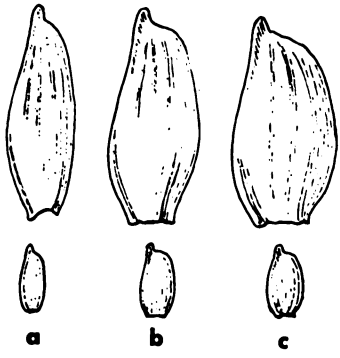

FIGURE 6.—Glume widths: *a*, Narrow; *b*, midwide; *c*, wide. (Upper row, × 3; lower row, × 1.)

The width of the glume is determined across its center from the keel to the margin of the outer side. Narrow glumes may range in width from 2.5 to 3.5 mm., midwide ones from 3.0 to 4.0 mm., and wide ones from 3.8 to 5.0 mm. The differences are small and much overlapping of the classes occurs. Wide glumes nearly cover the lemma at the point of measurement, whereas narrow glumes usually cover less than a third of it.

SHOULDER CHARACTERS

The shoulder is the more or less rounded end of the glume from the beak to the lateral margin, including the part referred to by Körnicke and Werner (*70*), Hackel (*50*), and others as side teeth. Scofield (*104*) applied the name "shoulder" to this part of the glumes.

Considerable variation exists in shoulder width and shape in different varieties and also in different spikes of the same variety and even among the glumes on a single spike. Although variable, they are of value in classification.

Width

The shoulder widths often differ from the glume widths. For this reason they are described separately but on the same basis of measurement and by the use of the same terms—narrow, midwide, and wide (fig. 7).

Shape

Shoulder shapes are described in overlapping terms that allow for a considerable variation, which is nearly always present in the same spike. The terms used are wanting, oblique, rounded, square, elevated, and apiculate (fig. 8).

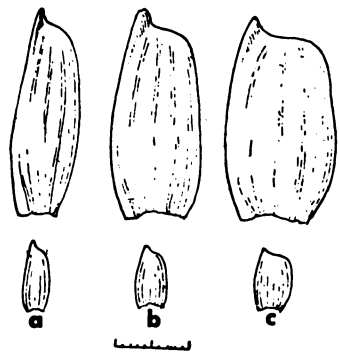

FIGURE 7.—Shoulder widths: *a*, Narrow; *b*, midwide; *c*, wide. (Upper row, × 3; lower row, × 1.)

BEAK CHARACTERS

The word "beak" is used for the short projection that terminates the keel of the outer glume. In some varieties it approaches an awn in appearance. Scofield (*104*) first used the term "beak"; previous authors had referred to it as a tooth or point. Beaks vary in width, shape, and length. These characters are of considerable importance in identification and are

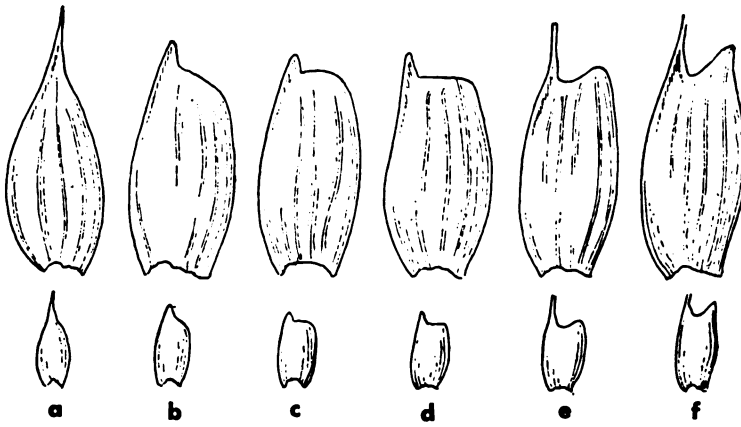

FIGURE 8.—Shoulder shapes: *a*, Wanting; *b*, oblique; *c*, rounded; *d*, square; *e*, elevated; *f*, apiculate. (Upper row, × 3; lower row, × 1.)

used in the descriptions of the varieties.

Width

Beak widths are described as narrow, midwide, and wide (fig. 9). The average beak is only 1 mm. wide, so the differences are very small, and general observation is the only basis for describing them. Those that are wider than the average are called wide and those that are narrower are called narrow.

Shape

The apex of the beak varies considerably in shape. It is described as obtuse, acute, and acuminate (fig. 10). Obtuse beaks are blunt at the apex. Acute beaks come to a point at the apex. Acuminate beaks are narrowly and very sharply pointed. Most awned spikes have acuminate beaks.

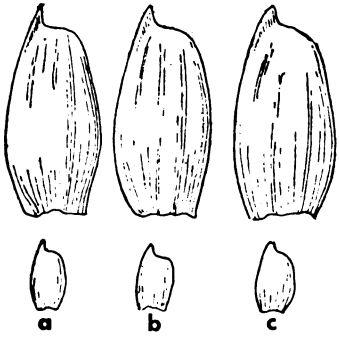

FIGURE 9.—Beak widths: *a*, Narrow; *b*, midwide; *c*, wide. (Upper row, × 3; lower row, × 1.)

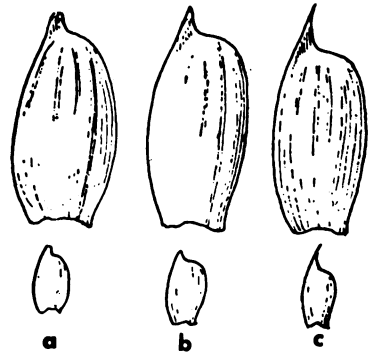

FIGURE 10.—Beak shapes: *a*, Obtuse; *b*, acute; *c*, acuminate. (Upper row, × 3; lower row, × 1.)

Length

Beak lengths vary, especially in the awned varieties, and are considerably influenced by environment. In general, conditions that increase or decrease the length of the beak affect nearly all varieties to a similar degree. In the awnless, apically awnleted, and awn-

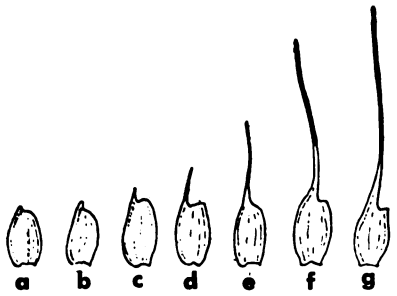

FIGURE 11.—Beak lengths, showing seven variations. (× 1.)

leted wheats the differences in length are not great, but usually they are distinct. The length of the beak is measured from the shoulder of the glume upward. On most awned wheats the length increases from the base of the spike to its apex. The range of difference varies greatly with the variety. For this reason no single measurement is used in describing the lengths, but instead the average maximum and minimum lengths are given. Variations in beak lengths are shown in figure 11.

AWN CHARACTERS

Certain characters of the awn are distinct. Some of these are important in classification; others are not. The divergence of the awn from the vertical is one that is not important. The awns of some varieties are all nearly vertical or appressed, whereas others are spreading. These characters are affected by drought or other abnormal conditions and usually are not sufficiently constant for classification purposes. The awns of some varieties are deciduous, dropping off at maturity. Langdon durum is an example. So few varieties have this characteristic that it is of little value in identification. The color and length of the awns, however, are of some importance in this classification.

Color

Awn color is used only as a minor character. Awns of common wheat varieties are described as white, white and black, or white and brown. The latter group is characteristic of varieties with brown glumes, the awns of which approach a light brown or tan color. Some durums are described as having white awns; some, white (yellow) awns; and some as having yellow awns. The white (yellow) class is intermediate. No black-awned durums are included in this bulletin.

Length

The length of the awn is of slight value in variety classification. No attempt has been made in these studies to separate the varieties into classes with respect to awn length although this character is distinctive in a few varieties. In all descriptions, however, the average extreme lengths are recorded in centimeters.

KERNEL CHARACTERS

The kernel color, length, and texture are the most constant of all kernel characters. These are used as major distinctions. The shape of the kernel is of minor importance, as are certain differences of the germ, crease, cheeks, and brush. *All determinations of kernel characteristics were based on observations made on kernels removed from the central one-third of a spike.*

Color

Kernel colors were early recognized as important characters in separating varieties. Most varieties were observed to have either white or red kernels but were sometimes regarded as being yellow or brown. Hayes, Bailey, Arny, and Olson (*53*) proposed the use of the

terms "red" and "white" in describing the presence and absence of a brownish-red pigment in the bran layer. Use of the modification "light red" was suggested where the degree of pigmentation was less than usual in the red wheats. Three varieties of Abyssinian wheat having violet-colored kernels were mentioned by Körnicke and Werner (*70*). Purple-kerneled wheats from Ethiopia (Abyssinia) are not considered in the present classification.

Kernels of all varieties are grouped into two classes, described as white and red, and, as in the glume colors, many shades are present. In general, however, the two classes distinctly separate all wheats.

Kernels of the white class vary from cream to yellowish, or they may be white, without pigment. White or faintly pigmented kernels may appear to have different shades of yellow because of differences in texture of the endosperm.

Kernels of the red class vary from light brown to the darker shades of red. The variations are due to varietal differences and environment. Differences in texture, due to varying conditions, may cause "yellow berries," which sometimes give the kernels a mottled appearance. Some samples have been received for identification in which kernels appeared to be partly red and partly white. As such kernels produce plants with only red kernels, this condition has been found to be the result of environment, although a genetic explanation has been suspected in some cases.

The color term "amber" is used to designate a subclass of white durum wheat in the United States official grain standards. Because wheats usually are either red or white, "amber" is not used in this bulletin in describing wheat kernels, except as a supplementary term for the durum class.

Length

The length of the kernel is used as a major character in distinguishing varieties.

The size of the kernels of any variety varies when it is grown in different locations or in different years in the same location. From necessity, therefore, the limits of the classes in which varieties are placed must be overlapping. A kernel of wheat reaches its maximum length several days before ripening. The length, therefore, is fairly constant, even when it is considerably shrunken, and is the most valuable of the kernel dimensions for taxonomic purposes. In making measurements only normal kernels should be used. The kernels from the tip spikelets on a spike and from the upper florets in the spikelet are below average length.

In the keys two classes are used, namely, kernels short to midlong and kernels long. In the descriptions three classes—short, midlong, and long, and sometimes combinations involving two of these—are mentioned. Kernel lengths are shown in figure 12.

The short to midlong class includes varieties with kernels that measure between 5.0 and 7.5 mm.

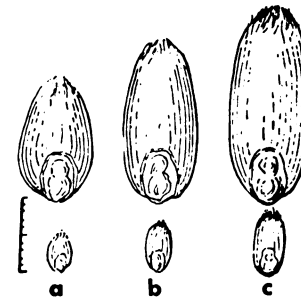

FIGURE 12.—Kernel lengths: *a*, Short; *b*, midlong; *c*, long. (Upper row, × 3; lower row, × 1.)

in length. The long class includes kernels that range from 7.0 to 8.5 mm. in length. For individual samples more definite limitation is possible. The term "short" is used for kernels from 5.0 to 6.5 mm. long, "midlong" for those from 6.0 to 7.5 mm. long, and "long" for those from 7.0 to 8.5 mm. long. All measurements were made from the tip of the germ to the base of the kernel, *not including the brush.*

Texture

The texture of wheat kernels is an important character in classification. It has an economic value, as most wheat is marketed in commercial classes, which are fixed largely on a basis of texture. Hard, common wheats generally are better for bread making than soft wheats. Soft wheats are used for cake, cookie, and pastry flour.

Two texture classes are used—kernels soft, and kernels semihard to hard. Here, as with size, overlapping class limits were found necessary. In general, all wheat varieties can be classed readily in one of these two groupings. In describing specific samples and in individual description of varieties, three classes are used separately, as soft, semihard, and hard. A soft kernel is one that, when normally developed, has an endosperm entirely soft, mealy, or starchy. A hard kernel, when normally developed, has a corneous, horny, or vitreous endosperm throughout. A semihard kernel has an endosperm that is intermediate between the other two.

The species *Triticum durum* was so named by Desfontaines (*38*) because of the hardness of the kernels. Because of the variability in texture under different environments one can separate varieties of wheat accurately into only two classes and fairly accurately into three classes. Soft-kerneled varieties grown under very dry conditions will sometimes become brittle and slightly corneous. When hard-kerneled varieties are grown under humid conditions or in soil deficient in nitrogen they sometimes become starchy, semistarchy, or mottled—the condition being designated as "yellow berry"—and the kernels are then rather soft.

The difficulty of numerous investigators in determining the kernel texture has been caused by failure to dissociate softness from starchiness or yellow berry. Freeman (*48*) has shown the nature of hardness in the wheat kernel. The following is quoted from his conclusions:

1. The hardness of a wheat is determined by the solidity of the grain, and this, in turn, by the nature and relative proportions of gluten and starch in the endosperm.

2. When the ratio of gluten to starch is sufficiently high, the entire cell contents are cemented together solidly as the grain dries out in ripening. It, therefore, takes on a hard, glassy, semitranslucent texture. In the absence of a sufficient proportion of gluten to hold the cell contents together, the shrinkage in drying does not fully compensate for the loss of water, and air spaces appear within the cells. These open spaces render the grain soft and, also, since they serve as refracting surfaces, make it opaque. We are, therefore, accustomed to associate softness, opaqueness, and low gluten content in wheats.

3. There are two types of soft grains among the wheats included in these experiments.

(a) A type designated by the writer as "true softness" in which the air spaces in the endosperm are diffuse and finely scattered. This type of softness is only slightly affected by environic conditions.

(b) A type commonly called "yellow berry," in which the air spaces within the endosperm occur in flakelike groups with quite definite margins. The opaqueness thus arising may be confined to a small spot only or may include the entire endosperm. This type of softness is very sensitive of environic conditions.

In this bulletin soft texture refers to the condition designated above as "true softness" and must not be confused with yellow berry.

True kernel texture, therefore, cannot be determined on yellow berry kernels, because they tend to be soft. It usually is possible, however, to select from a sample a few kernels that are not wholly starchy and that can be accurately used to determine texture. Roberts (*93*) attempted to measure hardness mechanically by determining the crushing strength. This is not entirely accurate, as the shape of the kernel influences its crushing strength and, in addition, soft-wheat varieties grown under dry-land conditions often are brittle and difficult to crush. The particle-size determination of Cutler and Brinson (*37*) and the pearling test of Taylor, Bayles, and Fifield (*114*) are useful in determining the texture of kernels. Texture in these studies was determined by cutting kernels not affected by yellow berry and examining the endosperm.

Shape

The shape of the kernel is described as ovate, elliptical, or oval (fig. 13). These terms refer only to the outline of the kernel as viewed from the dorsal surface, and not to the kernel as a whole. When the kernel is egg shaped—the germ end being the broader—it is described as ovate. An elliptical kernel is one the length of which is more than twice the width and that has sides somewhat curved and both ends rounded. An oval kernel is broader, like the ovate, but with both ends of nearly equal width. Modifications of these shapes are indicated. A few varieties, such as Baart, show other characteristic shapes, which are given in the descriptions of these varieties.

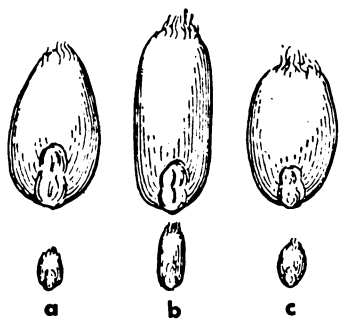

FIGURE 13.—Kernel shapes: *a*, Ovate; *b*, elliptical; *c*, oval. (Upper row, × 3; lower row, × 1.)

Most kernels are classified as ovate, but in a few varieties a considerable part of the kernels may have one or the other of the shapes just noted. The shape of the wheat kernel is influenced by the position in the spikelet, the position in the spike, and the degree of plumpness. Boshnakian (*12*) has shown that spikelet characters that affect the shape of the wheat kernel are mainly —

(1) The stiffness of the glumes, (2) the size and shape of the space in which the grain develops, (3) the number of grains in the spikelet and their position, (4) the density of the head, (5) the pressure caused by the growth of different parts of the head, and (6) the species that produces the kernel.

The kernels from the base or tip spikelets on the spike are shorter in proportion to width than the others. The kernels from club wheat or from the tip spikelets of clavate spikes of common wheats are usually laterally compressed or "pinched." Shrunken kernels usually have an elliptical shape because of being narrow. As the width of a kernel of wheat depends largely upon the degree of development of plumpness, this character has very little taxonomic value.

The tip, or bush, end of nearly all varieties is rounded, but the kernels of a few varieties, in which the tips are square rather than rounded, as seen from the dorsal view, are described as truncate. Kernels of a few varieties have acute or pointed tips, as seen in both dorsal and lateral view.

The shape of the kernel as seen in the lateral view is important in only a few varieties. Many varieties, especially durums and emmers, are more or less keeled on the dorsal surface. Normally the kernels of wheat, in dorsoventral diameter, are thickest near the base, just above the germ. In a few varieties the kernels are strongly elevated on the dorsal side of this basal portion and they are popularly known as "humped." That term is used in describing such kernels. When the dorsal portion is less keeled than normal the kernel is described as flattened. Where only the tip of the kernel is thus flattened it is described as having a flattened tip. The kernels of a few varieties when viewed from the side have a depressed dorsal surface about midway between the ends. This feature is referred to as swayback.

Wheat kernels cannot be accurately described according to shape unless they are normally developed, that is, neither shrunken nor excessively plump.

GERM CHARACTERS

The size and shape of the germ, or embryo, of the wheat kernel have seldom been used as characters in classification. Size of the germ is one of the most constant of minor kernel characters, although individual kernels in a bulk sample vary considerably. The germ is developed earlier than the endosperm and consequently is of almost normal size even in shrunken grain.

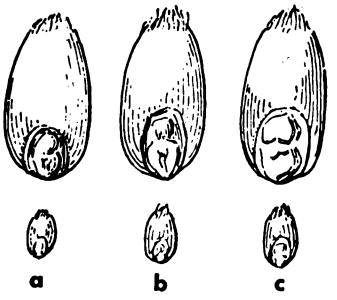

FIGURE 14.—Germ sizes: *a*, Small; *b*, midsized; *c*, large. (Upper row, × 3; lower row, × 1.)

The germ is here described as small, midsized, or large (fig. 14). A small germ is one that occupies less than ⅛ of the area of the dorsal surface of the kernel or the area visible in dorsal view. A midsize germ occupies from ⅛ to ¼ of the dorsal area of the kernel. A large germ occupies ¼ or more of the dorsal area.

The limits of the three size groups overlap. Most kernels have a midsized germ, so these characters are not much used in distinguishing varieties. For some varieties, however, they can be used to advantage.

CREASE CHARACTERS

The crease on the ventral side of the wheat kernel is rather variable but is of value in distinguishing a few varieties. The chief taxonomic character is the degree of openness as this pertains to width and depth. Shrunken kernels nearly always have a relatively wide and deep crease, whereas in extremely plump or yellow-berry kernels the crease is narrow and shallow, because the space beneath the bran is occupied by large starch cells and air spaces.

Width

The width of the crease is determined by the distance between the crests of the cheeks on each side of the crease. Creases are described as narrow, midwide, and wide (fig. 15). A narrow crease is about two-thirds or less of the total width of the kernel in ventral view. The midwide crease, which is typical of most varieties, is usually about four-fifths of the total kernel width. A wide crease is almost the total width of the kernel.

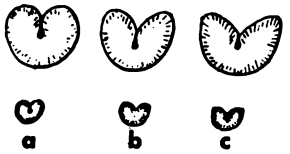

FIGURE 15.—Crease widths: *a*, Narrow; *b*, midwide; *c*, wide. (Upper row, × 3; lower row, × 1.)

Depth

The depth of the crease in this classification has been determined by a cross section of the kernel. The depth is judged from the crest of the cheeks to the position where the crease is closed. Crease depths are described as shallow, middeep, and deep (fig. 16). A shallow crease has a depth of 20 percent or less of the dorsoventral thickness of the kernel. A middeep crease has a depth of from 15 to 35 percent of the thickness of the kernel, and a deep crease has a depth of 30 to 50 percent of the thickness of the kernel.

The depth of the crease is of taxonomic value only when the kernels are normally developed and is a distinguishing character in only a few varieties. It is sufficiently constant, however, to be of use in describing varieties grown under identical and normal conditions. Nearly all the durum and club wheats have a shallow crease, as do many hard red winter varieties. A few varieties of common wheat have a "pitted" crease. This is characterized by a distinct opening near the center of the crease (fig. 16, *d*). The sides of the opening usually are wrinkled.

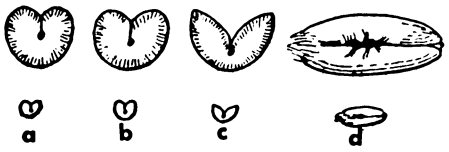

FIGURE 16.—Crease depths: *a*, Shallow; *b*, middeep; *c*, deep; *d*, pitted. (Upper row, × 3; lower row, × 1.)

CHEEK CHARACTERS

The cheeks of a kernel are the ridges along each side of the crease on the ventral surface of the kernel. The most distinguishing character of the cheek is the outline of the crest in cross section. This is rounded or angular (fig. 17). Extremely starchy kernels tend to have rounded cheeks; the cheeks of shrunken kernels are angular. It is necessary, therefore, to examine normally developed kernels to recognize the differences. There is no sharp distinction between the angular and the rounded cheeks.

FIGURE 17.—Cheek shapes: *a*, Rounded; *b*, angular. (Upper row, × 3; lower row, × 1.)

BRUSH CHARACTERS

The brush of the kernel is the hair at the tip or the end opposite the germ.

Size

The size of brush refers to the area that it occupies on the kernel. It is described as small, midsized, and large (fig. 18). A small brush occupies only a part of the tip of

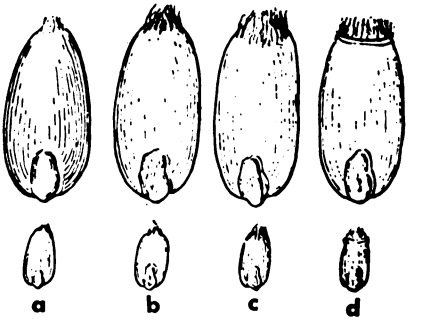

FIGURE 18.—Brush sizes: *a*, Small; *b*, midsized; *c*, large; *d*, collared brush. (Upper row, × 3; lower row, × 1.)

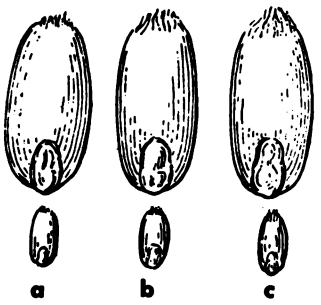

FIGURE 19.—Brush lengths: *a*, Short; *b*, midlong; *c*, long. (Upper row, × 3; lower row, × 1.)

the kernel. In kernels that are distinctly pointed at the tip, however, it may cover all of the end. A midsized brush covers the tip of the kernel. Nearly all varieties of wheat are within this class. A large brush is one that extends partly over the sides of the kernel, chiefly along the crease.

Length

The length of brush refers to the average length of hairs, which are described as short, midlong, and long (fig. 19). The hairs of a short brush are less than 0.5 mm. long, of a midlong brush from 0.5 to 1 mm. long, and of a long brush more than 1 mm. long. A few very long hairs may be present in a short brush.

All domestic durum wheats and some varieties of common wheat have a short brush. Both size and length of brush are very constant characters, probably the most constant kernel characters aside from color and size. In machine threshing, part of the hairs of the brush frequently are removed.

Collar

The brush area of some varieties is "collared" (fig. 18, *d*). This refers to the presence of a distinct raised collar or flange of bran along the margin of the brush area. This is most noticeable on shrunken kernels, but is very distinct on normal kernels of a few varieties.

PRODUCTIVITY

A comparison of yield of different varieties of wheat is of value only when the varieties are grown under identical conditions, as side by side, on identical soil, and in one locality in the same season. Not all varieties are equally adapted to growing under any one set of specific conditions, and so all cannot express full yield potential. Under certain conditions it is possible for almost any variety to outyield all others, and consequently an expression of yield is of little taxonomic importance.

RESISTANCE TO DISEASES AND INSECTS

Wheat varieties are known that have resistance to many diseases of wheat and to some insects. Nearly all varieties of wheat herein considered have been observed for reaction to one or more diseases including stem rust, leaf rust, stripe rust, bunt, loose smut, powdery mildew, and one or more virus diseases, or were exposed to infestation by hessian fly, sawfly, or aphids. Immunity and resistance can be determined when varieties are exposed equally to a disease or insect under conditions favorable for development. When a variety is known to be resistant to a disease or to an insect, this fact is noted following the varietal descriptions.

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HARDINESS

Hardiness is the ability of the plant to resist low temperatures, heaving, winter drought, and other factors that may injure or kill the plant. In winter wheats, resistance to low temperatures consists of the ability to survive low winter temperatures; in spring wheats, it is the ability to resist injury from spring, summer, or fall frosts. Winterkilling in the hard red winter region is more commonly caused by low temperatures and drought, while in the more humid soft winter wheat region of the Eastern States it is often caused by heaving as well as low temperatures without snow cover. Following the varietal descriptions, particular hardiness characteristics are pointed out for several varieties.

QUALITY

Next to productivity, the value of wheat varieties for milling and for making bread, cake, pastries, macaroni, and other food products is of the greatest economic importance, as these are the principal uses for wheat. Flour from hard red winter, hard red spring, and hard white varieties is used mostly for breadmaking. The soft white common, club, and soft red common varieties are used mostly for the manufacture of cake, cookie, pastry, biscuit, and cracker flours, for breakfast cereal products, or for bread when blended with high protein hard wheats. Durum varieties are used for macaroni and similar products. Varieties differ greatly in their usefulness for these various products. As with yield, these differences can be accurately determined only by careful experiments, conducted with comparably grown samples. The percentage of protein in grain is determined to a great extent by the environment under which it is grown, but some varieties are consistently higher or lower than others. The quality of the protein is determined chiefly by variety, but is modified by environment.

Quality attributes are discussed for each variety described. The determinations are based on experiments conducted by the U.S. Department of Agriculture and cooperating State and private agencies but mainly in laboratories as follows:

Western Wheat Quality Laboratory, Pullman, Wash.
Hard Winter Wheat Quality Laboratory, Manhattan, Kans.
Eastern Soft Wheat Quality Laboratory, Wooster, Ohio.
Hard Spring and Durum Quality Laboratory, Beltsville, Md.

Collaborative tests with commercial mill laboratories and certain State laboratories have supplied many useful data.

CLASSIFICATION OF *TRITICUM* SPECIES

Each division of vascular plants is composed of subordin[illegible] ranged in order of rank as they [illegible]ommon wheat, they are: (Taxa—singular taxon)

Taxon	*Example*	*English Name*
Division	Spermatophyta	Seed plants
Class	Angiospermae	Flowering plants
Subclass	Monocotyledoneae	Monocots
Order	Graminales	
Family	Gramineae	Grass
Tribe	Hordeae	
Genus	Triticum	Wheat
Species	aestivum	
Subspecies	vulgare	Common wheat
Variety	Thatcher	

Wheat belongs to the grass family Gramineae (Poaceae) and to the tribe Hordeae, in which the one- to several-flowered spikelets are sessile and alternate on opposite sides of the rachis, forming a true spike.

Wheat is characterized as a mid-tall annual grass with flat blades and a terminal spike. The spikelets are solitary, one- to five-flowered, sessile, arranged alternately on the nodes of a zig-zag, channeled, articulate rachis; the glumes keeled, rigid, three- to several-nerved, obtuse, acute, or acuminate; the lemmas keeled or rounded on the back, many-nerved, ending in a single tooth or awn.

Classification of wheat became significant with the work of Linnaeus in 1753. Previously, botanists had generally adopted the classification of cultivated wheats referred to by Columella (*34*). They were divided into two sections, namely: species of *Triticum* —wheats with a tough rachis and loosely held kernels, and species of *Zea*—wheats with a fragile rachis and kernels held firmly enclosed by the glumes (*88*).

Linnaeus, in his Species Plantarum (*74*) described:

1. *Triticum aestivum* (bearded spring wheat)
2. *T. hybernum* (be less winter wheat)
3. *T. turgidum*
4. *T. spelta*
5. *T. monococcum*
6. *T. repens*
7. *T. caninum*

The latter two were later assigned to another genus. He apparently believed that all common spring wheats were awned and all common winter wheats were awnless. In the second edition of the Species Plantarum (*75*) he added *T. polonicum*.

Lamarck in 1778 (*71*) established the species *T. sativum* to include *T. aestivum*, *T. hybernum*, and *T. turgidum*, species which Linnaeus had adopted.

Villars in 1787 (*118*) divided the common wheats into two species, *T. vulgare* (*T. aestivum* L.) and *T. touzella* (*T. hybernum* L.).

Schrank in 1789 (*103*) recognized two cultivated species and suggested a third:

1. *T. cereale* (with varieties *aestivum* and *hybernum*)
2. *T. spelta* L.
   T. dicoccon (cultivated emmer)

Desfontaines in 1798 (*38*) established the species *T. durum* for the group of wheats having long awns and long vitreous kernels.

Host in 1805 (*59*, *v. 3*) was the first to include *T. aestivum* and *T. hybernum* of Linnaeus as one species under the name *T. vulgare*. He also described and named the species *T. compactum* to include the club wheats (*59*, *v. 4*) and in addition recognized 10 other species of the genus *Triticum* (*88*).

Seringe in 1818 (*106*) described eight species which were divided into two sections.

Metzger in 1824 (*83*) followed essentially the same system as Seringe, omitting one species.

Seringe in 1841 (*107*) published a revision of his previous work of 1818. He classified the eight species under the three genera *Triticum*, *Spelta*, and *Nivieria*.

Alefeld in 1866 (*7*) divided the wheats into two genera. Polish wheats were placed in the genus and species *Deina polonica*, and all others in nine groups under *T. vulgare*.

Heuzé in 1872 (*55*) grouped the wheats into seven species. *T. sativum* included both common and club wheats.

Körnicke in 1885 (*70*), recognized three species of wheat.

1. *T. vulgare* Vill.
2. *T. polonicum* L.
3. *T. monococcum* L.

T. vulgare was divided into six subspecies including *T. vulgare* Vill., *T. compactum* Host, *T. turgidum* L., *T. durum* Desf., *T. spelta* L., and *T. dicoccum* Schrk.

Harz in 1885 (*52*) considered common and club wheats as a single species.

Hackel in 1890 (*50*) classified the genus *Triticum* according to a key very similar to that used by Körnicke and Werner (*70*). Hackel recognized three species, *T. sativum* Lam., *T. monococcum* L., and *T. polonicum* L.; and three races of *sativum*, namely, *spelta*, *dicoccum*, and *tenax*. Under *tenax* he listed *vulgare*, *compactum*, *turgidum*, and *durum* as subraces.

Vilmorin in 1889 (*119*) considered common and club wheats as one species.

A number of other authors including Persoon, Bayle-Barelle, Lagasca, Clemente, Roemer and Schultes, Schübler, Link, and Vilmorin, published various classifications of wheat between the years 1800 and 1900, according to Percival (*88*).

Flaksberger in 1915 (*43*) published extensive treatises on the taxonomy of Russian wheat forms.

Percival in 1921 (*88*) published his classification of the genus *Triticum*. With the exception of three new races, the listing and chief distinguishing characters of Percival's groups, whether termed races or species, are similar to those given by Seringe. Percival recognized only two species:

Species 1. *T. aegilopoides* Bal. — wild small spelt
Race 1. *T. monococcum* L. — small spelt
Species 2. *T. dicoccoides* Körn. — wild emmer
Race 2. *T. dicoccum* Schübl. — emmer
Race 3. *T. orientale* Perc. — Khorasan wheat
Race 4. *T. durum* Desf. — macaroni wheat
Race 5. *T. polonicum* L. — Polish wheat
Race 6. *T. turgidum* L. — rivet or cone wheat
Race 7. *T. pyramidale* Perc. — Egyptian cone wheat
Race 8. *T. vulgare* Host — bread wheat
Race 9. *T. compactum* Host — club wheat
Race 10. *T. sphaerococcum* Perc. — Indian dwarf wheat
Race 11. *T. spelta* L. — large spelt or dinkel

Sakamura in 1918 (*96*) reported the chromosome number for each of the species or subspecies listed by Hackel. His counts were verified by Sax (*99*), Kihara (*66*, *67*, *68*), Watkins (*125*), and others. This period marks a turning point in the classification of *Triticum*. It was then recognized that wheats fell naturally into three groups, based on number of chromosomes. The diploid had 14 chromosomes (n=7), the tetraploids 28 (n=14), and the hexaploids 42 (n=21). Disagreements arose, however, in the assignment of species (or fur-

ther subdivisions) within these three groups.

Zhukovsky in 1928 (*126*) described a new species, *T. timopheevi* Zhuk., which has 28 chromosomes.

Vavilov and associates in 1931 (*117*) published an account on wheats of Abyssinia, which was a contribution to the knowledge of the 28 chromosome groups of cultivated wheats.

Vasconcelos in 1933 (*116*) classified the wheats of Portugal into *T. vulgare*, *T. compactum*, *T. turgidum*, *T. durum*, and *T. polonicum*.

Flaksberger in 1935 (*44*) presented the results of extensive studies on the origin and classification of the species and varieties of wheat in the world.

Maugini in 1939 (*82*) described the wheats of Abyssinia and Eritrea, which included *T. dicoccum*, *T. durum*, *T. pyramidale*, *T. turgidum*, *T. polonicum*, *T. vulgare*, and *T. compactum*.

Flaksberger and coworkers in 1939 (*46*) revised and enlarged his earlier publications on the species and varieties of the world. His classification of the genus *Triticum* was followed by Bayles and Clark (*10*), and Clark and Bayles (*23*). The species recognized by Flaksberger and his associates, grouped according to chromosome number, with their common names used in the United States, were as follows:

Diploid series	*Tetraploid series*	*Hexaploid series*
14 chromosomes	28 chromosomes	42 chromosomes
T. spontaneum Flaks., wild einkorn.	*T. dicoccoides* Körn., wild emmer.	*T. spelta* L., spelt.
T. monococcum L., einkorn.	*T. timopheevi* Zhuk., timopheevi.	*T. vulgare* (Vill.) Host (*T. aestivum* L.), common wheat.
	T. dicoccum (Schrank) Schübl., emmer.	*T. compactum* Host, club wheat.
	T. durum Desf., durum wheat.	*T. sphaerococcum* Perc., shot wheat.
	T. abyssinicum Vav., Abyssinian wheat.	*T. macha* Dek. & Men., macha.
	T. turgidum, L., poulard wheat.	
	T. polonicum L., Polish wheat.	
	T. persicum Vav., Persian wheat.	

Schiemann in 1948 (*100*) and 1951 (*101*) and von Rosenstiel in 1950 (*95*) classified the genus *Triticum* in much the same manner as did Flaksberger (*46*), except for differences in nomenclature and incorporation of *T. compactum* in *T. aestivum*, under the name of *T. aestivum*—aestivo-compactum.

Schiemann (*101*) in an Appendix on Nomenclature accepted use of *T. aestivum* L. instead of *T. vulgare* Vill. in spite of the fact that since 1787 the name *T. vulgare* had been used in both scientific and practical papers. She replaced *T. aegilopoides* (Link) Bal. (wild einkorn) with *T. boeoticum* Boiss. and indicated that Flaksberger was not entitled to use the name *T. spontaneum* Flaks. for this species. Schiemann also defended use of *T. carthlicum* Nevski, an older homonym, in lieu of *T. persicum* Vav., and the adoption of *T. turanicum* Jakubz. for *T. orientale* Perc. She stated that Jakubziner changed the name of this tetraploid wheat in 1940.

Mangelsdorf in 1953 (*81*) discussed genealogy of wheat and

followed Flaksberger's classification of the genus *Triticum*, except for omitting one tetraploid species described by Flaksberger—*T. abyssinicum* Vav.

Mac Key in 1954 (*78*) proposed one species for the hexaploids with special forms in the rank of subspecies. Schiemann (*101*) listed only one, *compactum*, as a subspecies. According to Mac Key it is inconsistent to place only one hexaploid in the subspecies rank since there are no real species barriers between any of them. They can be crossed easily and chromosome pairing at meiosis may be as normal in crosses between the different hexaploids as in crosses within one of the hexaploids. Mac Key's subspecies correspond to the groups of 6x wheats which generally had been regarded as independent species. Mac Key (*78*) states that "According to the nomenclature rules, *T. aestivum* L., em. Thell. is to be regarded as the *nomen legitimum* when considering all hexaploid wheats as comprising one species only." His system of classifying the hexaploids is as follows:

Species

Triticum aestivum **L. em. Thell.**

Subspecies

ssp. ***compactum*** **(Host) Mac Key**
ssp. ***sphaerococcum*** **(Perc.) Mac Key**
ssp. ***vulgare*** **(Vill., Host) Mac Key**
ssp. ***spelta*** **L. Thell.**
ssp. ***macha*** **(Dek. et Men.) Mac Key**

Jakubziner in 1958 (*62*) classified the *Triticum* genus into 3 diploids, 11 tetraploids, and 7 hexaploids. They are listed as follows:

Diploid species	*Tetraploid species*	*Hexaploid species*
T. boeticum Boiss.	*T. araraticum* Jakubz.	*T. zhukovskyi* Men. & Er.
T. urartu Tum.	*T. dicoccoides* (Körn.) Schweinf.	*T. macha* Dek. & Men.
T. monococcum L.	*T. timopheevi* Zhuk.	*T. spelta* L.
	T. paleocolchicum Men.	*T. aestivum* L.
	T. dicoccum Schübl.	*T. compactum* Host
	T. durum Desf.	*T. vavilovii* Jakubz.
	T. turgidum L.	*T. sphaerococcum* Perc.
	T. turanicum Jakubz.	
	T. polonicum L.	
	T. carthlicum Nevski	
	T. aethiopicum Jakubz.	

A new 28-chromosome wheat species, not listed here, originating from the high-mountain regions of Iran, had not yet been described in publication (*62*), according to Jakubziner.

Bowden in 1959 (*13*) grouped *Triticum* L. and *Aegilops* L. into one genus. He put the allotetraploid wheats into a single species of hybrid origin, with the designation *T. turgidum* L. emend. Bowden. Hexaploids were listed as variety groups, under the collective species name *Triticum* × *aestivum* L. emend. Bowden. Bowden's proposed classification of *Triticum* tetraploids and hexaploids is as follows:

Tetraploid species

T. turgidum L. emend. Bowden
1. Groups of cultivated varieties:
   a. turgidum
   b. polonicum
   c. dicoccon
   d. durum
   e. carthlicum
   f. palaeocolchicum
   g. turanicum
   h. aethiopicum
2. var. dicoccoides
3. var. timopheevi
   a. f. timopheevi
   b. f. zhukovskyi
4. var. tumanianii

Hexaploid species

T. × *aestivum* L. emend. Bowden
1. Groups of varieties:
   a. aestivum
   b. spelta
   c. compactum
   d. sphaerococcum
   e. macha
   f. vavilovii

Bowden treats allopolyploid species of interspecific hybrid origin, such as *T. ovatum*, *T. triaristatum*, and others, in a separate category.

Sears in 1959 (*105*) adopted Mac Key's classification of the hexaploid group and added one more subspecies. His treatment of the diploid and tetraploid groups follows that of Schiemann. Sears' classification of the species of *Triticum* follows:

		Diploid group n=7	Tetraploid group n=14	Hexaploid group n=21
Wild forms		*T. boeoticum* Boiss. em. Schiem. (=*aegilopoides* Bal.)	*T. dicoccoides* Körn. *T. timopheevi* Zhukov	
Cultivated forms	Spelt types	*T. monococcum* L.	*T. dicoccum* Schübl.	*T. aestivum* L. em. Thell. ssp. *spelta* (L.) Thell. *T. aestivum* ssp. *macha* (Dek. et Men.) Mac Key *T. aestivum* ssp. *vavilovi* (Tuman.) Sears
	Naked types		*T. durum* Desf. *T. turgidum* L. *T. turanicum* Jakubz. (=*orientale* Perc.) *T. polonicum* L. *T. carthlicum* Nevski (=*persicum* Vav.)	*T. aestivum* ssp. *vulgare* (Vill., Host) Mac Key *T. aestivum* ssp. *compactum* (Host) Mac Key *T. aestivum* ssp. *sphaerococcum* (Perc.) Mac Key

The need for a simple system of classification is critical. In future years wheat breeders will likely intercross hexaploid wheats even more than has been done. Natural groups, now considered as subspecies, will probably be even more difficult to recognize as separate entities, even though the principal distinguishing characteristics are in many cases the expression of a major gene. The subspecies *compactum*, *spelta*, and *sphaerococcum* differ individually from *vulgare* by only one gene (*105*). Most wheat breeders the world over have concentrated on crosses involving *vulgare* and *compactum*, but as the need arises for new and more variable germ plasm, the other hexaploid subspecies will likely be used through intercrossing.

Tetraploid *Triticum* species and other genera (*Agropyron*, for example) have been crossed with hexaploids as well, and it is inevitable that these sources will be used to a greater extent in the future. Synthesized 6x wheats that are derivatives from other species and genera pose a problem in classification. Many could be recognized as new species or subspecies, but if this were generally done, a classification scheme would be long and cumbersome. Mac Key (*78*) does not include them in his treatment of the hexaploid wheats. Breeders ordinarily use them only as parents in a program designed to incorporate genes into *T. aesti-*

vum ssp. *vulgare* and ssp. *compactum*.

Sears (*105*) adopted Schiemann's system for the tetraploids and listed them as separate species, but he considers each of the hexaploids as subspecies. *T. carthlicum* differs from *T. dicoccum* by the same gene, Q, as distinguishes ssp. *vulgare* from ssp. *spelta*. Both *T. turgidum* and *T. polonicum* differ from *T.* durum essentially by single genes. The tetraploids have not been intercrossed as much as have some of the hexaploids, however, and each tends to be fairly distinct within the group. Sears points out that the different tetraploid species cross freely, and that sometime in the future it may become desirable to relegate each to the rank of subspecies within a single tetraploid species.

Sears (*105*) and Mac Key (*78*) accepted the fact that the name *T. vulgare*, long applied to common wheat, can no longer be used legitimately as a species name. They each indicated that use of *vulgare* as the subspecies name would be advantageous, in that it has been used so widely in the literature. Sears' classification of the genus *Triticum* (*105*) is accepted in this bulletin.

Only one of the tetraploid species, *T. durum*, is of commercial importance in the United States. Two of the *T. aestivum* subspecies, *vulgare* and *compactum*, are grown on a commercial scale. In years past small acreages of *T. aestivum* ssp. *spelta*, *T. dicoccum*, *T. polonicum*, and *T. turgidum* were grown, principally as feed for livestock. They have virtually disappeared from commercial production in the United States. The other species and subspecies have been grown only for experimental purposes, and have been used in breeding and genetic investigations.

The species and subspecies of *Triticum* are distinguished in the following key:

KEY TO SPECIES AND SUBSPECIES

1a. Haploid chromosome number 7. Page
- 2a. Spikes disarticulate (disjoint) at maturity; rachis internodes remain attached by their apex to the base of the spikelet; glumes tenacious, tightly closed.
  - 3a. Palea in fertile florets split at maturity.
    - Spikes small, flat, awned; spikelets usually contain one developed kernel (occasionally two).
      - Rachis joints densely pubescent, long bristles directed upward form dense beards at base of spikelets.
        - Rachis extremely fragile ..... *T. boeoticum* .. 38
    - Spikes wider in 2-rowed profile [1] than in *T. boeoticum*.
      - Rachis joints glabrous or pubescent.
        - Rachis not as fragile as in *T. boeoticum* ..... *T. monococcum* .. 39

1b. Haploid chromosome number 14.
- 2a. Spikes disarticulate at maturity; rachis internodes remain attached by their apex to the base of the spikelet; glumes tenacious, tightly closed.
  - 3b. Palea in fertile florets not split at maturity.
    - Spikes lax, much narrower across face than 2-rowed profile; awns long.
      - Rachis joints densely pubescent, long bristles directed upward form dense beards at base of spikelets.
        - Rachis extremely fragile ..... *T. dicoccoides* .. 39
    - Spikes dense and ovate shape, narrower across face than 2-rowed profile; awns mid-long; rachis moderately fragile.
      - Rachis internodes pubescent on edges.
        - Glumes wing shaped, keeled from apex to base, densely pubescent, beaks prominent.
          - Leaves hairy on both surfaces ..... *T. timopheevi* .. 40

[1] As viewed from the narrow dimension of the rachis so that the spikelets appear to form two rows.

1b. Haploid chromosome number 14—Continued

2a. Spikes disarticulate at maturity—Continued

3b. Palea in fertile florets not split at maturity—Continued

Spikes dense, laterally compressed, narrower across face than the 2-rowed profile; awned; rachis moderately fragile.

Rachis internodes pubescent on edges or almost glabrous; rachis narrow.

Glumes long and narrow, outer face flat, keeled from apex to base, beaks short ..... *T. dicoccum* .. 41

2b. Spikes do not disarticulate at maturity; kernels separate from chaff when threshed.

Spikes dense, square or narrower across face than 2-rowed profile; awns long (awnless forms rare).

Glumes long and midwide, keel curved, prominent from apex to base.

Kernels long, very hard in texture, usually elliptical ... *T. durum* ... 41

Glumes short and midwide, shorter than lemmas (cover about ⅔ of the lemma); keel prominent from apex to base.

Spikes simple or branching.

Kernels somewhat short, ovate, with truncate tips ... *T. turgidum* .. 41

Spikes long and very lax; almost square; awned; (awns scabrid to base).

Glumes long and narrow, shoulders very narrow.

Kernels very long, narrow, flinty .. *T. turanicum* (=*orientale* Perc.). 44

Spikes large, lax or compact, awned, square or narrower across face than 2-rowed profile.

Glumes membranous, as long as or longer than lemmas, lanceolate, many-nerved, keeled from apex to base.

Kernels very long, narrow, flinty ..... *T. polonicum* .. 47

Spikes resemble those of common wheat (*T. aestivum* ssp. *vulgare*) in that face is wider than or almost equal to 2-rowed profile.

Rachis internodes approximately half as wide as in common wheat; spike very flexible.

Beaks long, extend into awn usually somewhat shorter than lemma awn ..... *T. carthlicum* (=*persicum* Vav.). 47

1c. Haploid chromosome number 21.

2a. Spikes disarticulate at maturity; rachis internode (in most cases) remains attached by its apex to the base of the spikelet; glumes tenacious, tightly closed.

Spikes lax or dense (dense forms resemble *dicoccum*); much wider across 2-rowed profile than face, giving spike a very flat appearance; rachis moderately fragile.

Glumes variable shape, midlong; shoulders narrow; beaks acute *T. aestivum* ssp. *macha* .. 47

Spikes middense to lax, glumes short, wide, nerves and keel visible from apex to base.

Rachis brittle (more resistant to breaking than *spelta* and *macha*).

Rachilla of spikelet elongated, giving the spike a branched appearance *T. aestivum* ssp. *vavilovi* .. 47

2b. Spikes do not disarticulate at maturity; kernels separate from chaff when threshed.

Spikes dense to lax; face of spikes wider than or equal to 2-rowed profile (cross section round to square); awned or awnless.

Glumes variable shape, usually distinctly keeled only in upper half.

Spikes long in relation to width ..... *T. aestivum* ssp. *vulgare* 50

Spikes short, dense, laterally compressed, usually wider across 2-rowed profile than face ..... *T. aestivum* ssp. *compactum* .. 50

Spikes dense; awned, awns short, rough; glumes and lemmas rounded; distinctly convex to semispherical; kernels rounded to almost spherical ..... *T. aestivum* ssp. *sphaerococcum* .. 50

2c. Spikes disarticulate at maturity; base of rachis internode opposite back of the spikelet remains attached to base of the spikelet; glumes tenacious.

Spikes very lax, long in relation to width; cross section round to almost square; short awned or awnless.

Rachis broad.

Glumes generally with wide, square shoulders and short, obtuse beak ..... *T. aestivum* ssp. *spelta* .. 50

DESCRIPTION OF SPECIES AND SUBSPECIES

Triticum boeoticum Boiss. em. Schiem., Wild einkorn

Wild einkorn may be either spring or winter habit.

The spikes are small, narrow and flat, and are very fragile—disarticulation proceeds from the tip down. Apical spikelets often fall while the basal ones are still green. The apex of the rachis internodes remains attached to the base of the spikelets upon disarticulation.

Spikelets are two-flowered, the lower one fertile and the upper one generally sterile. The palea in

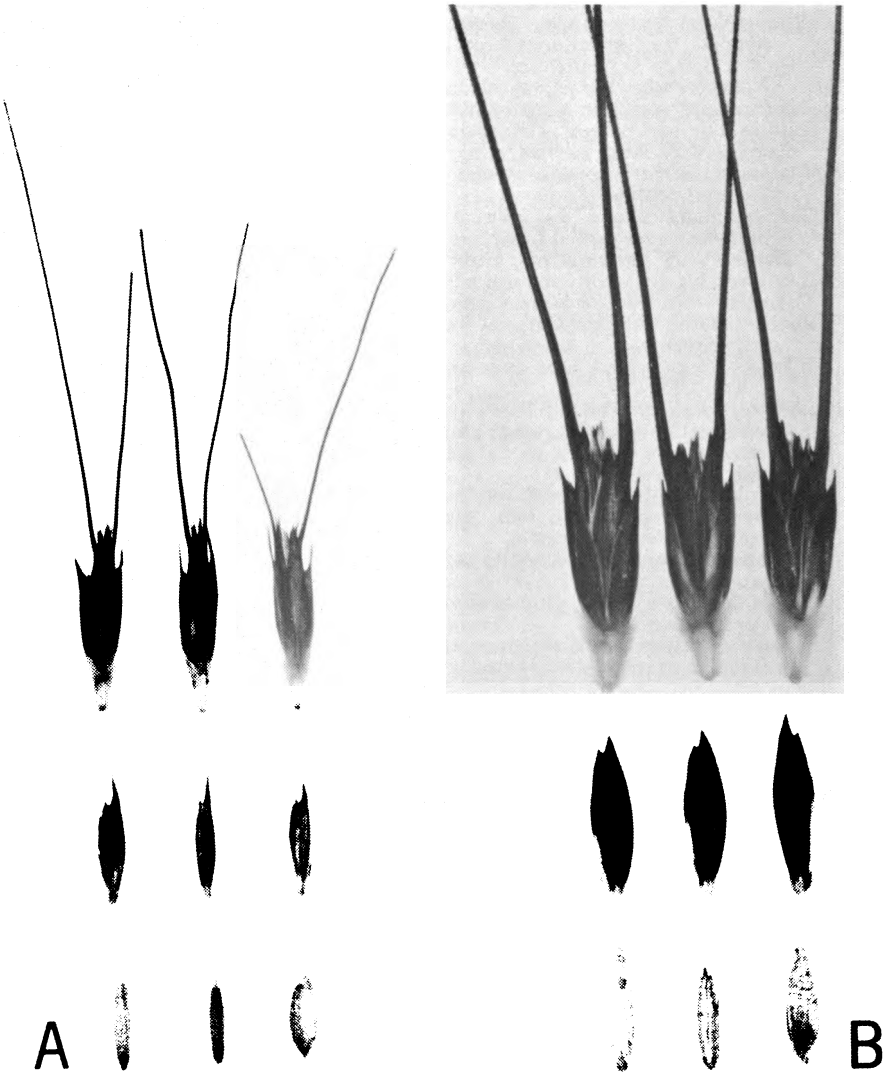

FIGURE 20.—*A*, *T. boeoticum* and *B*, *T. dicoccoides*: spikelets, glumes, and kernels, × 1½.

fertile florets splits into two parts at maturity. A tuft of bristles (1.5 to 3 mm. long) is attached to the rachis in front at the base of each spikelet.

Glumes are sharply keeled, dentate (prominent nerve ends in a tooth), and are tenacious (tightly enclose the kernel).

Kernels are red, laterally compressed so that the crease is partly obscured, and have a flinty endosperm.

Wild einkorn grows as a grass in the Balkans and Anatolia (*101*).

A spikelet, glumes, and kernels of wild einkorn are shown in figure 20, *A*. It is seldom possible to obtain a complete spike, due to extreme fragility of the rachis.

Triticum monococcum L., Einkorn

Einkorn, one of the most primitive of the cereals, is little different from the wild *T. boeoticum*. Its cultivation was established in prehistoric times (*88*). Einkorn, or one-grained wheat, has no English name but is called einkorn in German, and that name has become fairly well known in North America.

Both winter and spring forms are known.

The spikes are awned, narrow, slender, and laterally compressed, but somewhat wider than *T. boeoticum*. Spikes are fragile—the apex of the rachis internodes remain attached to the base of the spikelets upon disarticulation. The spikelets usually contain only one fertile floret, for which reason it is called one-grained wheat. The palea in fertile florets splits into two parts at maturity.

Glumes are sharply keeled and dentate.

The kernels remain in the spikelets after threshing, and are pale red, slender, and very much laterally compressed. The kernel crease is almost wanting.

Schiemann (*101*) reported relic cultures in Europe, Anatolia, and North Africa.

A spike, glumes, spikelets, and kernels of einkorn are shown in figure 21.

Triticum dicoccoides Körn., Wild emmer

Wild emmer is usually of winter habit.

The spikes are lax, laterally compressed, and have long, stiff awns. The flattened rachis is smooth and shiny with a fringe of conspicuous hairs along the edges. In front at the base of each spikelet is a tuft of bristles which sometimes extends across the rachis. The spike is extremely fragile and spikelets readily fall to the ground at maturity. Spikelets near the apex become detached first, the others breaking off in order toward the base. The apex of the rachis internodes remains attached to the base of the spikelets. After falling to the ground the spikelets seem to creep into crevices and are buried. The hairs on the rachis and the scabrid (rough) awns are effective in accomplishing this (*87*).

Spikelets are large. Usually there are 3 flowers but only 2 seeds generally develop.

Glumes are extremely tenacious, very sharply keeled, and scabrid.

The bases of the culms of mature plants curve away from each other in a characteristic decumbent manner, the plants appearing to occupy a considerable area (*87*).

Wild emmer grows in the area from Palestine to Transcaucasia (*101*).

Spikelets, glumes, and kernels of wild emmer are shown in figure 20, *B*. It is virtually impossible to obtain a complete spike.

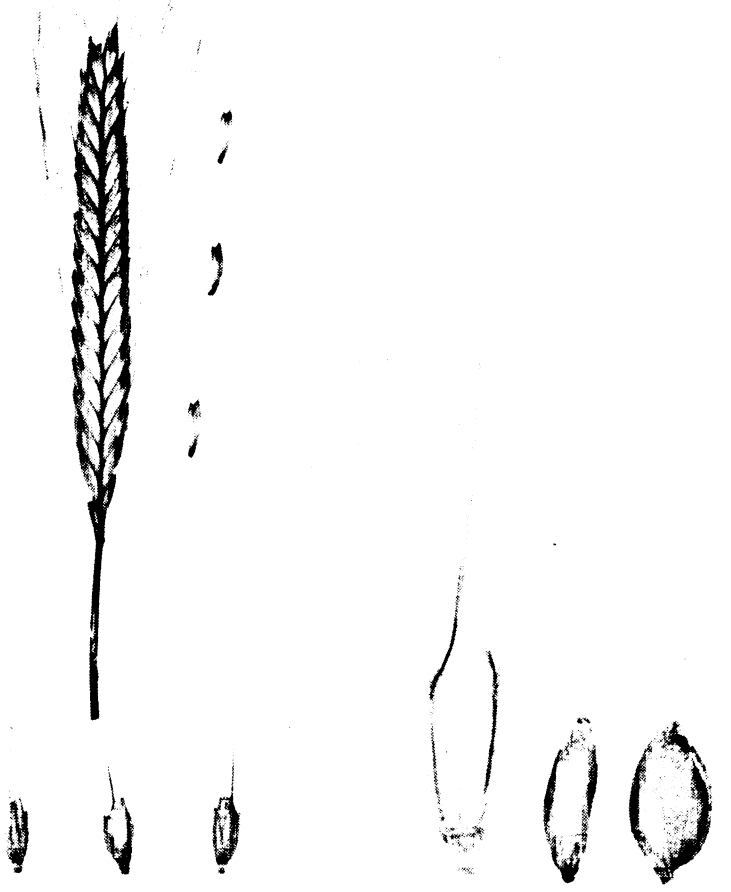

FIGURE 21.—*T. monococcum*: spike, glumes, and spikelets, × 1; spikelet and kernels, × 3.

Triticum timopheevi Zhuk.

Timopheevi is a late maturing spring species.

Spikes are very compact, broad across the 2-rowed profile, and pyramidal in shape (*126*). Awns are soft, thin, and short to mid-long. Rachis internodes are pubescent on the edges. The rachis is not nearly so fragile as in *T. dicoccoides*. When the spike disarticulates the apex of the rachis

internodes remains attached to the base of the spikelets.

Spikelets generally contain two kernels.

Glumes are tenacious, sharply keeled, densely pubescent, and much shorter than the lemma. One nerve is conspicuous. The beaks are prominent and acute.

A characteristic peculiar to this species is the presence of long, white, tough hairs on the leaf sheaths. Leaf blades are pubescent on both surfaces.

Kernels are midlong, slender, red, and have a flinty endosperm.

Cytological studies of Kihara (*69*) have shown that timopheevi belongs to the emmer group but contains one genome apparently not present in other species of *Triticum*.

T. timopheevi occurs in Transcaucasia (*101*).

A spike, glumes, spikelets, and kernels of timopheevi are shown in figure 22.

Triticum dicoccum Schübl., Emmer

Emmer may be of either winter or spring habit. The leaves often are pubescent.

The spikes are very dense and laterally compressed, being narrow when viewed from the face and wide across the 2-rowed profile. Most emmers are awned. The rachis internode is short and narrow. When the spike disarticulates the rachis internode remains attached by its apex to the base of the spikelet.

The spikelets are flattened on the inner side and usually contain two flowers.

Glumes are tenacious, long, narrow, and are keeled from the apex to the base. Beaks are short.

The kernels, which remain enclosed in the glumes after threshing, are red or white, slender, and both ends are acute.

Emmer is distinguished from spelt by the shorter, denser spikes, which are laterally compressed. The rachis internode of emmer is shorter and narrower and remains attached by its apex to the base of the spikelet, while in spelt the base of the rachis internode opposite the back of the spikelet remains attached to the base of the spikelet. Emmer kernels usually are darker red and harder in texture than those of spelt. Since emmer and spelt are so different, reference to emmer by the name "speltz" is discouraged.

Emmer is one of the most ancient of cultivated cereals (*88*). Schiemann (*101*) reported that relic cultures occur in Europe, Southwest Asia, and India.

A spike, glumes, spikelets, and kernels of emmer are shown in figure 23.

Triticum durum Desf., Durum

Description of the species *T. durum*, and description, history and distribution of durum varieties grown in the United States are found on pages 52 to 58.

Triticum turgidum L., Poulard wheat

The poulard wheats may be of either winter or spring habit and usually are tall with broad leaves. The culms are thick, and generally solid or pithy.

The spikes are usually long and dense and occasionally compound or branched. They have a tough rachis and do not disarticulate at maturity. Spikes are square or wider across the 2-rowed profile than across the face. Awns are long.

FIGURE 22.—*T. timopheevi:* spike, glumes, and spikelets, × 1; spikelet and kernels, × 3.

FIGURE 23.—*T. dicoccum:* spike, glumes, and spikelets, × 1; spikelet and kernels, × 3.

Glumes are short, midwide, and have a prominent keel from the apex to the base. They cover about two-thirds of the lemma.

The kernels are free-threshing, somewhat short, ovate, humped, and have truncate tips. They range in texture from hard to very starchy.

The poulards are most closely related to the durums. The glumes and kernels usually are shorter, the kernels are thicker in the dorsoventral diameter and are softer in texture than the durums. In many instances the varieties of poulard and durum are so nearly alike that it is difficult to distinguish them.

Poulard wheat is grown in those countries bordering the Mediterranean, in the Near East, and in Abyssinia (*101*). Some is also grown in parts of Europe.

Poulard wheat has often been advertised in the United States as a high yielding type, particularly those varieties with branched heads. It does not yield as much as adapted common or durum varieties and is poor in bread baking and in macaroni quality.

A spike, glumes, and kernels of poulard wheat are shown in figure 24.

Triticum turanicum Jakubz. (=*orientale* Perc.)

This wheat is of spring habit and is early in maturity.

Spikes are very long and lax, and are almost square in cross section. Awns are long, scabrid to the base, and often black. The spikes have a tough rachis which does not disarticulate at maturity. Sides of the rachis are fringed with white hairs, and there is a frontal tuft below each spikelet.

Spikelets produce 2 to 3 kernels.

Glumes are long and narrow with very narrow shoulders. They are keeled from the apex to the base.

FIGURE 24.—*T. turgidum:* spike and glumes, × 1; kernels, × 3.

Kernels are free-threshing, very long, narrow, white and flinty. They have a short brush.

Leaves are narrow and pubescent (*88*). The plants tiller very little, and the straw is thin-walled.

T. turanicum is grown in the Mediterranean area, the Near East, and Abyssinia (*101*).

A spike, glumes, and kernels of *T. turanicum* are shown in figure 25.

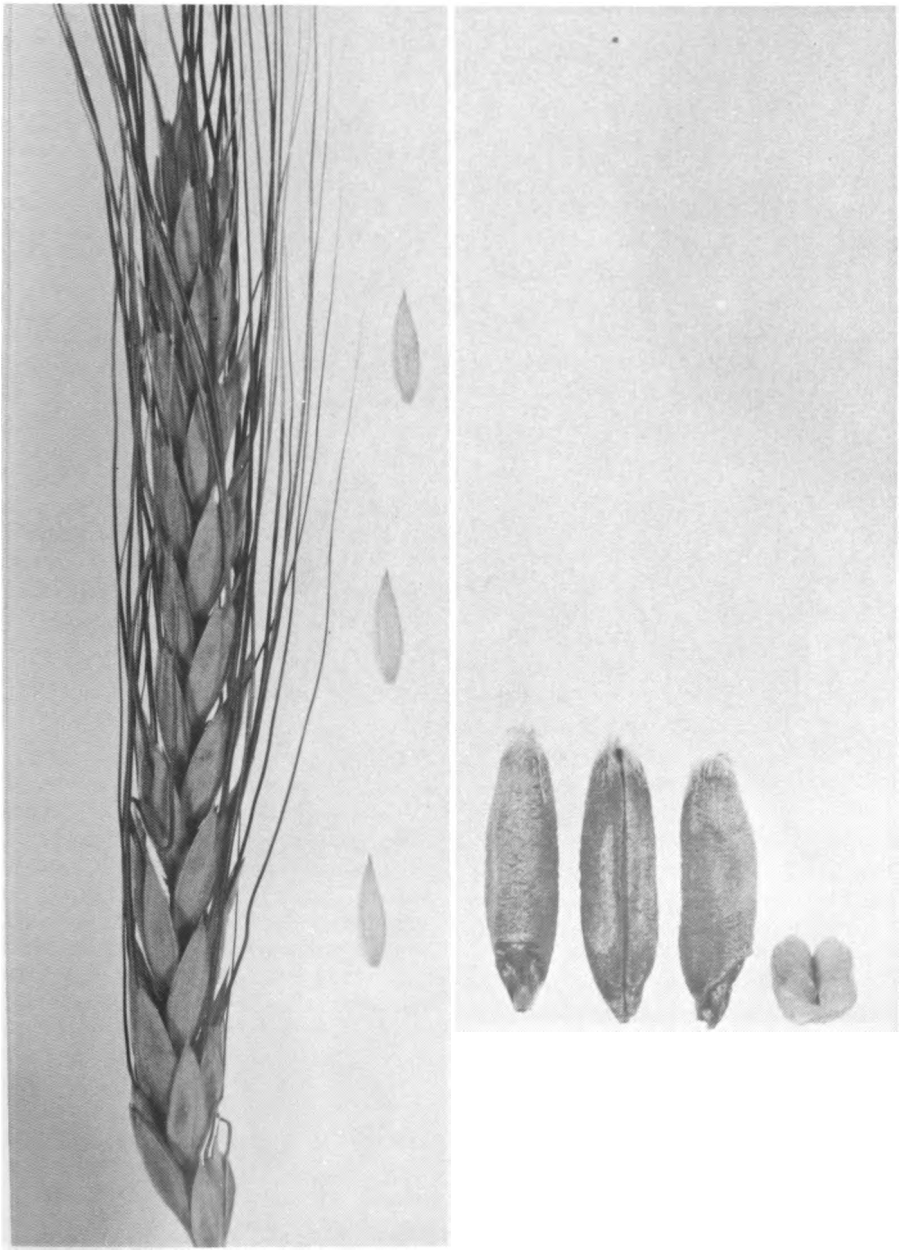

FIGURE 25.—*T. turanicum:* spike and glumes, × 1; kernels, × 3.

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FIGURE 26.—*A*, *T. polonicum* and *B*, *T. carthlicum:* spike and glumes, × 1; kernels, × 3.

Triticum polonicum L., Polish wheat

Polish wheat has a spring habit. Plants are tall.

Spikes are large, lax or compact, awned, and are square or wider across the 2-rowed profile than across the face. The rachis is tough and does not disarticulate at maturity.

Glumes are membranous, very long, narrow, lanceolate, and keeled from the apex to the base. They are as long as or longer than the lemmas. Several nerves are conspicuous.

The kernels are free-threshing, very long, narrow, and flinty.

Polish wheat is grown in countries bordering the Mediterranean, in the Near East, and in Abyssinia (*101*).

Polish wheat has produced lower yields than adapted common and durum varieties in the United States, and is of inferior value for bread or macaroni products.

A spike, glumes, and kernels of *T. polonicum* are shown in figure 26, *A*.

Triticum carthlicum Nevski. (=*persicum* Vav.)

Persian wheat is of spring habit. Most varieties are early in maturity.

Spikes resemble those of common wheat in that the face is wider than or equal to the 2-rowed profile. Rachis internodes are about one-half as wide as in common wheat, and are smooth or have very little pubescence. The rachis is tough and does not disarticulate at maturity. Spikes of Persian wheat are very flexible.

Several flowers are present in the spikelet, but generally 3 kernels develop.

Glumes are indistinctly keeled at the base. The beak extends into an awn which is usually somewhat shorter than the awn on the lemma—thus the spike appears densely awned.

Kernels of Persian wheat are free-threshing, flinty, and generally red. They resemble those of common wheat.

T. carthlicum is grown in the area bordering the Mediterranean, in the Near East, and in Abyssinia (*101*).

A spike, glumes, and kernels of Persian wheat are shown in figure 26, *B*.

Triticum aestivum ssp. *macha* (Dek. et Men.) Mac Key, Macha

Macha has a winter or intermediate habit of growth, and is late in maturity. The straw is hollow and the plants tall.

Spikes are lax or dense. Lax forms resemble *T. spelta* and dense forms resemble *T. dicoccum*. Awns are short. Spikes of the dense forms are much wider across the 2-rowed profile than the face, and appear very flat. The spikes disarticulate upon threshing. The apex of most rachis internodes remains attached to the base of the spikelets, as in *T. dicoccum*.

Glumes are variable in shape. They are keeled from the apex to the base. Shoulders are narrow and beaks acute.

The kernels remain in the spikelets after threshing. They are elliptical, red, and intermediate between starchy and flinty.

T. macha is grown in Transcaucasia (*101*).

A spike, glumes, spikelets, and kernels of *T. macha* are shown in figure 27.

Triticum aestivum ssp. *vavilovi* (Tuman.) Sears

This subspecies is of winter habit and midseason in maturity. The straw is thick and very strong (*61*).

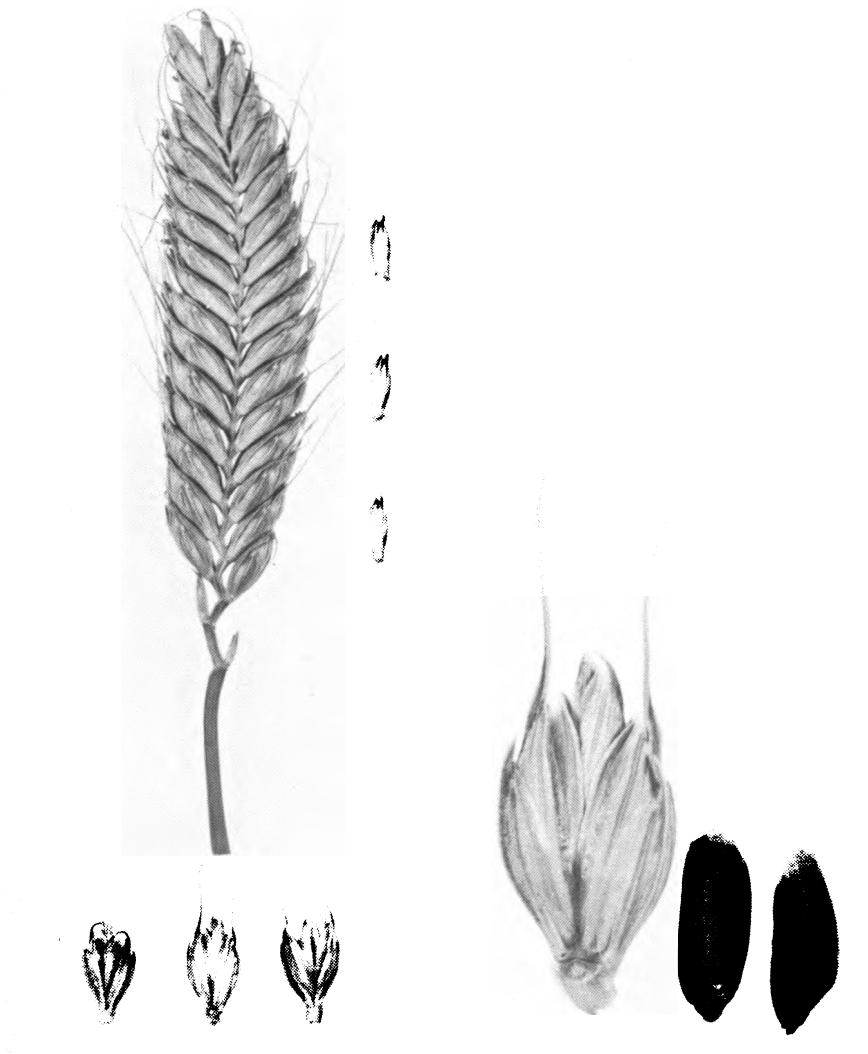

FIGURE 27.—*T. aestivum* ssp. *macha:* spike, glumes, and spikelets, × 1; spikelet and kernels, × 3.

Spikes are middense to lax, short awned, and resemble those of *T. spelta.* Elongation of the rachillas gives *T. vavilovi* spikes a branched appearance. This characteristic is unique and does not occur in other *Triticum* species or subspecies (*110*). The rachis is brittle but more resistant to breaking than *T. spelta* or *T. macha.* When the spikes disarticulate the apex of the rachis internodes remains attached to the base of the spikelets.

Glumes are coarse, wide, and have a square shoulder. They are keeled from the apex to the base and several nerves are visible. The beaks are short and obtuse. Glumes

are a gray smoke color, black, or white.

The kernels remain in the spikelets after threshing. They are oval or ovate, white, and flinty. Protein content is higher than most wheats (*61*).

T. aestivum ssp. *vavilovi* was found in East Anatoli as a mixture with a local common wheat (*61*).

A spike, glumes, spikelets, and kernels of *T. vavilovi* are shown in figure 28.

FIGURE 28.—*T. aestivum* ssp. *vavilovi:* spikes, glumes, and spikelets, × 1; spikelet and kernels, × 3.

Triticum aestivum ssp. *vulgare* (Vill., Host) Mac Key, Common wheat

Description of the species *T. aestivum* ssp. *vulgare* and description, history, and distribution of common wheat varieties grown in the United States are found on pages 58 to 116.

Triticum aestivum ssp. *compactum* (Host) Mac Key, Club wheat

Description of the species *T. aestivum* ssp. *compactum* and description, history, and distribution of club wheat varieties grown in the United States are found on pages 116 to 119.

Triticum aestivum ssp. *sphaerococcum* (Perc.) Mac Key, Shot wheat

Shot wheat is of spring habit and is early in maturity. The straw is short and stiff.

Spikes are awnless or short-awned (awns are stiff), dense, and have a tough rachis. They do not disarticulate at maturity. Spikes appear square in cross section.

From 6 to 7 florets are found in a spikelet, and 4 or 5 may produce kernels.

Glumes and lemmas are rounded —distinctly convex to semispherical—and have an inflated appearance. The glumes are short with wide beaks which are curved inward. Both pubescent and nonpubescent forms occur.

Kernels are unique; they are shorter and more rounded (almost spherical) than kernels of other wheats. The lemma and palea of each floret tightly enclose the kernels but shot wheat is free-threshing. Kernels are either red or white and generally soft in texture.

Shot wheat is grown in Northwest India (*101*).

FIGURE 29.—*T. aestivum* ssp. *sphaerococcum*: spike and glumes, × 1; kernels, × 3.

A spike, glumes, and kernels of shot wheat are shown in figure 29.

Triticum aestivum ssp. *spelta* (L.) Thell., Spelt

Spelt may be either winter or spring habit.

Spikes are very lax, long, and round or almost square in cross section. They are awnless or short-awned. The rachis is brittle. After threshing the base of the rachis internodes opposite the back of the spikelets remains attached to the base of the spikelets.

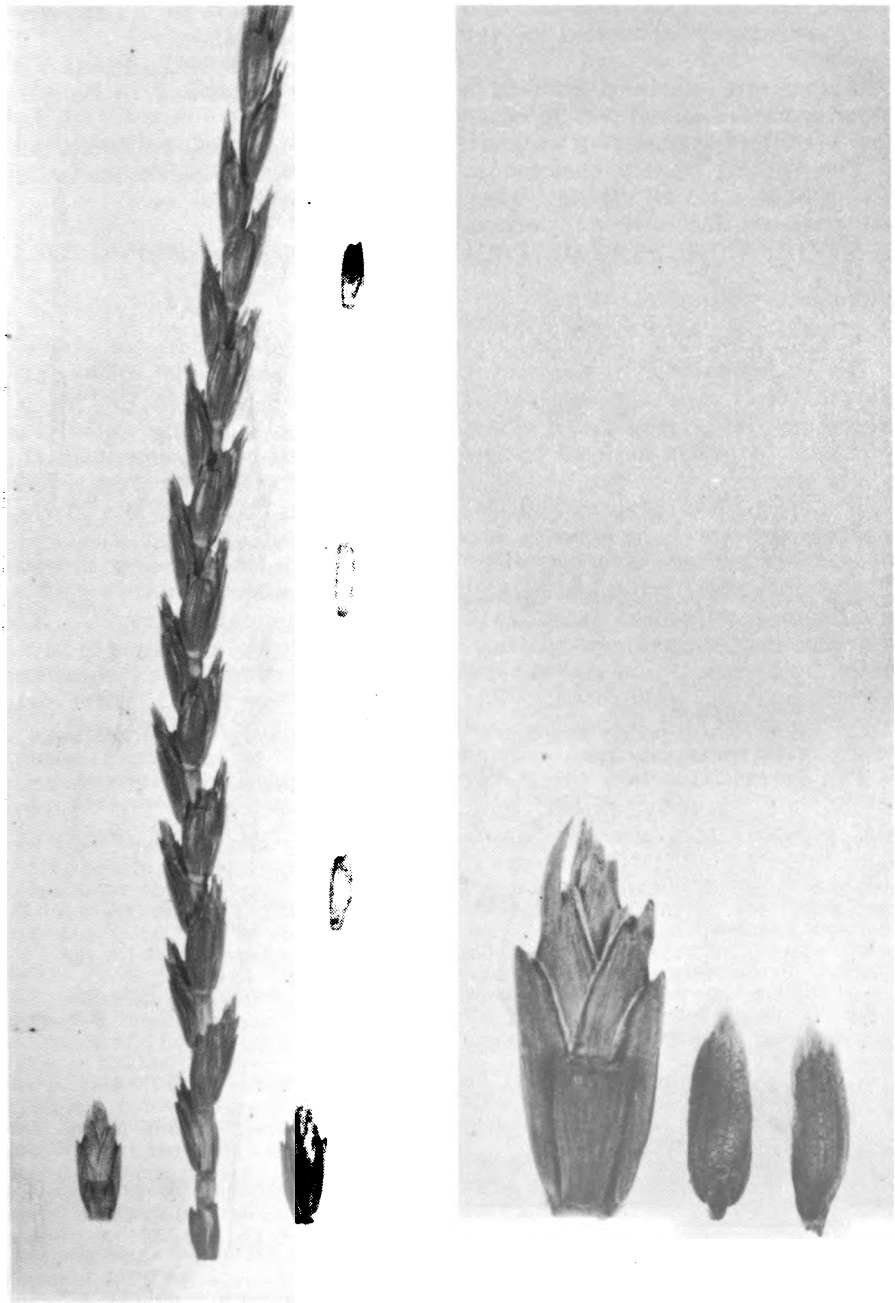

FIGURE 30.—*T. aestivum* ssp. *spelta:* a spike glumes, and spikelets, × 1, spikelet and kernels, × 3.

The spikelets are two-kerneled and are closely appressed to the rachis.

Glumes are tenacious and have wide, square shoulders. The beaks are short and obtuse.

The kernels remain enclosed in the glumes after threshing. They are pale red, laterally compressed, and have an acute tip. The crease is narrow and shallow.

Spelt is grown in the Rhine Valley, from Switzerland to Belgium (*101*).

A spike, glumes, spikelets, and kernels of spelt are shown in figure 30 on page 51.

DURUM WHEAT

All commercial varieties of durum wheat grown in the United States are of spring habit. The peduncle is pithy, at least in the upper part.

The spikes are compact and laterally compressed, and hence are narrower when seen in a face view. The glumes are sharply keeled, and the lemmas are awned except in a few awnless forms that were originated by hybridization and are not in commercial production. The awns are long and coarse and are white, yellow, or black.

The kernels are free threshing, white, and usually rather long and pointed; they are very hard and translucent, which gives them an amber appearance. Red seeded forms, common among world durums, are not represented in this bulletin. The kernels always have a short brush and are the hardest of all known wheats.

The durum wheats, as already stated, are sometimes very similar to certain poulard varieties. The spikes, however, usually are much thinner, the glumes are longer, and the kernels are longer, more slender, and usually much harder.

Durum wheat has been widely grown in the United States only since about 1900. The durum wheat area has moved northward

KEY TO VARIETIES

		Page
1a. Spike awned.		
2a. Glumes white.		
3a. Kernels long.		
Glumes more tenacious than on other commercial durums	YUMA	53
2b. Glumes yellow.		
3a. Kernels long.		
Plant midtall, early.		
Beaks acuminate, 2 to 4 mm. long, shoulders elevated	SENTRY	53
Plant midtall to tall, early to midseason.		
Beaks acute, 2 mm. long, shoulders rounded to elevated	LANGDON	55
Plant tall, midseason or late.		
Spike oblong to fusiform, dense to middense.		
Beaks acuminate, 1 to 5 mm. long, shoulders oblique	MINDUM	55
Beaks acute, 1 mm. long, shoulders rounded	STEWART	55
Spike oblong, dense.		
Beaks acute, less than 0.5 mm. long, shoulders narrow to wanting, oblique	TOWNER	56
Beaks acute, 0.5 mm. long, shoulders narrow to wanting, oblique to rounded	RAMSEY	56
3b. Kernels midlong.		
Plant short, early.		
Predominant beak type 3 to 5 mm. long		
Brush very short	WELLS	56
Predominant beak type 5 to 15 mm. long.		
Brush short to midlong	LAKOTA	58

until the center of production is now in northeastern North Dakota. The durums furnish the great bulk of the world's supply of wheat for the manufacture of semolina, which is made into macaroni, spaghetti, and similar products. Production of durum wheat in the United States has made possible a large macaroni industry.

The varieties that are commercially grown are distinguished by the accompanying key.

DESCRIPTION, HISTORY, AND DISTRIBUTION OF VARIETIES

YUMA

Description.—Plant spring habit, midseason, short to midtall; stem light purple, midstrong; spike awned, oblong, dense, inclined to nodding; glumes glabrous, white, long, midwide, more tenacious than on any other commercial durum; shoulders narrow, elevated; beaks very wide, acute, 1 to 2 mm. long; awns white and black, 4 to 14 cm. long; kernels white (amber), long, hard, elliptical; germ midsized; crease wide, shallow; cheeks angular; brush midsized, short.

Yuma is moderately susceptible to leaf rust and resistant to stem rust, including race 15B, and to powdery mildew. It is resistant to bunt and loose smut.

Yuma is lower in test weight than Langdon, Ramsey, or Towner. It is high in protein content and has strong gluten. Yellow pigment (carotenoid) content is high. Macaroni products made from Yuma are not considered equal to those from other commercial varieties because of the slightly reddish-gray cast to the finished product.

History.—Yuma (C.I. 13245) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. It is an F_4 selection from the first backcross involved in the development of Langdon. Resistance of Yuma to stem rust and to powdery mildew is derived from the Khapli emmer parent. Yuma was tested as Ld 364 and was entered in the Uniform Spring Wheat Regional Performance Nursery in 1954. Seed was increased in Yuma County, Ariz., during the winter of 1954–55. Yuma was released in 1956 by the North Dakota Agricultural Experiment Station (*54*).

Distribution.—Yuma was grown on an estimated 5,429 acres in 1959, mostly in South Dakota (*91*).

SENTRY

Description.—Plant spring habit, early, midtall; stem white, midstrong; spike awned, oblong, dense, inclined; glumes glabrous, yellow, long, narrow to midwide; shoulders narrow, elevated; beaks wide, acuminate, 2 to 4 mm. long; awns white or yellow, occasionally black, 5 to 12 cm. long; kernels white (amber), long, hard, elliptical; germ midsized to small; crease midwide, shallow; cheeks angular to rounded; brush small, short.

Sentry has some tolerance to race 15B of stem rust, which, in combination with early maturity, generally enables it to escape serious damage. It does not provide adequate protection against 15B in a severe epidemic. It is resistant to many other races of stem rust and to leaf rust. "Black point" fungus discolors the germ end of the kernels in some years. Sentry is resistant to bunt and loose smut.

Sentry has high test weight, high protein content, and medium to high yellow pigment (carotenoid) content. Gluten from Sentry is rather weak. Difficulty in processing because of sticky characteristics of the gluten has been reported. Sentry generally produces macaroni products of good cooking quality and color.

History.—Sentry (C.I. 13102) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. It is a selection from a cross made in 1948 between Nugget and a selection from the double cross Heiti-Stewart × Mindum-Carleton. Heiti is an early maturing, erect, short strawed variety introduced into this country from Australia. The F_4 was grown in the greenhouse in the spring of 1950 and the F_5 in the field under the first 15B stem rust epidemic in the summer of 1950. One of the F_5 rows was the progenitor of Sentry. This selection was designated as Ld 356 and entered in the Uniform Spring Wheat Regional Performance Nursery in 1953. Sentry was released by the North Dakota Agricultural Experiment Station in 1954 (*8*).

Distribution.—Sentry was grown on an estimated 30,505 acres in 1959, about half of which were in North Dakota. California and South Dakota grew most of the rest (*91*).

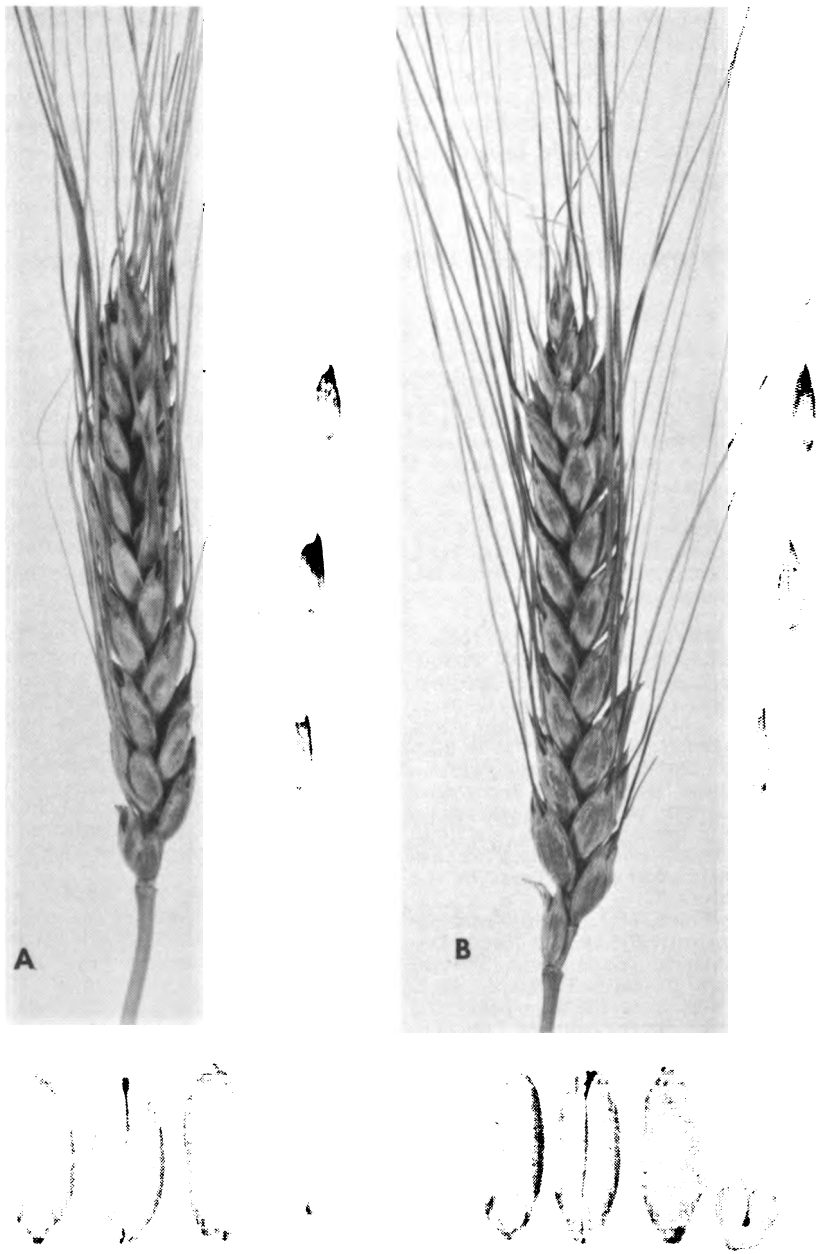

FIGURE 31.—*A*, Langdon and *B*, Mindum durums: spikes and glumes, × 1; kernels, × 3.

LANGDON

Description.—Plant spring habit, early to midseason, midtall to tall; stem white, midstrong to strong; spike awned (awns dehisce at maturity), oblong, dense, nodding; glumes glabrous, yellow, long, midwide; shoulders narrow, rounded to elevated; beaks wide, acute, 2 mm. long; awns white to yellow, 4 to 16 cm. long; kernels white (amber), long, hard, elliptical; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized, short. (See fig. 31, *A.*)

Langdon is resistant to many races of stem rust but is susceptible to some isolates of race 15B. It is moderately susceptible to leaf rust and resistant to bunt and loose smut.

Langdon is high in test weight and semolina yield. It produces macaroni products of desired color. Its cooking properties are satisfactory.

History.—Langdon (C.I. 13165; reg. 385) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. Resistance to stem rust race 15B was derived from Khapli emmer. Development of Langdon involved four successive crosses in a modified backcross procedure. The first cross between a Mindum × Carleton selection (Ld 194) and Khapli emmer was made in 1944. A resistant F_3 progeny was crossed with Ld 308, a selection from Heiti-Stewart × Mindum-Carleton. The third cross was made in 1950 between Stewart and a resistant F_2 plant from the second cross. An F_1 plant of this combination was crossed with Carleton in the spring of 1951. Langdon descends from a single plant in the third generation following the final cross. Mindum makes up a very high proportion of the parentage in all four durums used as "backcross" parents. The selection destined to become Langdon was designated Ld 372 and entered in the Uniform Spring Wheat Regional Performance Nursery in 1954. Seed was increased in the winter of 1954–55 in Arizona. Langdon was released by the North Dakota Agricultural Experiment Station in 1956 (*54, 80*).

Distribution.—Langdon was the leading variety of durum in 1959. It was grown on 777,918 acres, mostly in North Dakota. Smaller acreages were grown in South Dakota, Montana, and Minnesota (*91*).

MINDUM

Description.—Plant spring habit, midseason, tall; stem white, midstrong to weak; spike awned, oblong to fusiform, dense to middense, nodding; glumes glabrous, yellow, midlong, narrow; shoulders narrow, oblique; beaks wide, acuminate, 1 to 5 mm. long; awns white, 6 to 18 cm. long; kernels white (amber), long, hard, elliptical; germ midsized; crease midwide, shallow; cheeks angular; brush midsized, short (essentially no brush). (See fig. 31, *B.*)

Mindum is resistant to leaf rust and to several races of stem rust. It is susceptible to races 15B and 17 of stem rust. It is resistant to bunt and loose smut.

Mindum has long been considered the standard for quality among durums. Macaroni products made from semolina milled from Mindum are translucent and have a highly desirable yellow color. Mindum tends to produce a lower percentage of semolina than many other varieties of similar test weight.

History.—Mindum (C.I. 5296; reg. 214) was first grown in 1896 in a nursery at University Farm, St. Paul, Minn., as a head selection from a field of common wheat called Hedgerow. It proved to be a rust-resistant strain of durum wheat and was distributed to farmers in 1917, and named Mindum in 1918 (*10*).

Distribution.—Mindum was grown on an estimated 62,333 acres in 1959, more than half of which were in North Dakota. Nearly one-third of the acreage was in Montana (*91*).

STEWART

Description.—Plant spring habit, late, tall; stem white, midstrong; spike awned, oblong to fusiform, dense to middense, inclined; glumes glabrous, yellow, long, midwide; shoulders narrow to wanting, rounded; beaks wide, acute, 1 mm. long; awns white, 10 to 18 cm. long; kernels white (amber), long, hard, elliptical; germ midsized; crease midwide, middeep; cheeks angular; brush small, short.

Stewart is resistant to many races of stem rust, but not to 15B. It is resistant to leaf rust, moderately resistant to bunt, and resistant to loose smut.

Like Mindum, Stewart has excellent macaroni quality. It averages higher than Mindum in test weight, yield of semolina, and protein content. It is high in yellow pigment (carotenoid) content.

At maturity the awns of Stewart are easily broken off, giving the spikes an irregular appearance.

History.—Stewart (C.I. 12066; reg. 334) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. It is a selection from a cross between Vernel emmer and Mindum backcrossed

twice to Mindum. The original cross, Vernal × Mindum, was made in 1930. A selected F_3 progeny was backcrossed to Mindum in 1932, from which an F_4 progeny was again backcrossed to Mindum in 1936. An F_4 selection of this second backcross, or Mindum^3 × Vernal, grown in 1938, was tested as Ld 111 and later increased and named Stewart (*8*). It was entered in the Uniform Spring Wheat Regional Performance Nursery in 1941. The variety was developed at the Langdon substation of the North Dakota Agricultural Experiment Station, and released in 1943.

Distribution.—Stewart was grown on an estimated 44,342 acres in 1959, all in Montana (*91*).

TOWNER

Description.—Plant spring habit, midseason, tall; stem white, midstrong; spike awned, oblong, dense, inclined to nodding; glumes glabrous, yellow, long, midwide; shoulders narrow to wanting, oblique; beaks midwide to wide, acute, less than 0.5 mm. long; awns white to yellow, 6 to 16 cm. long; kernels white (amber), long (slightly shorter than those of Langdon and Ramsey), hard, elliptical; germ midsized; crease wide to midwide, middeep to shallow; cheeks angular to rounded; brush small, very short.

Towner is resistant to leaf rust and appears to have the same reaction to stem rust as Ramsey. It is resistant to bunt and loose smut.

Towner has high test weight. In some years the yellow pigment (carotenoid) content tends to be low and macaroni products made from the semolina do not have the desired yellow color. Cooking quality of the macaroni is satisfactory.

Chlorotic spots form on the leaves in some seasons.

History.—Towner (C.I. 13247) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. It is from the same cross as Ramsey, Carleton × P.I. 94701, made in 1950. The F_4 generation was grown in the greenhouse in the spring of 1952 and the F_5 in the field in the summer of 1952. One of the F_5 rows selected was designated as Ld 370 and entered in the Uniform Spring Wheat Regional Performance Nursery in 1954. Seed was increased in the winter of 1954–55 in Arizona. This selection was released by the North Dakota Agricultural Experiment Station as Towner in 1956. Yield tests have indicated that it is best adapted to the northern part of the durum growing area (*54*).

Distribution.—Towner was grown on an estimated 12,706 acres in 1959, all in North Dakota (*91*).

RAMSEY

Description.—Plant spring habit, midseason, tall; stem white, midstrong; spike awned, oblong, dense, inclined to nodding; glumes glabrous, yellow, long, midwide; shoulders narrow to wanting, oblique to rounded; beaks wide, acute, 0.5 mm. long; awns white to yellow, 3 to 16 cm. long; kernels white (amber), long, hard, elliptical; germ midsized; crease midwide, shallow; cheeks rounded; brush small, very short. (See fig. 32, *A*.)

Ramsey is resistant to leaf rust and is moderately resistant to the isolates of 15B stem rust prevalent at the time of its release. Since then, however, other isolates of 15B have become established which are virulent on Ramsey. Resistance of Ramsey to 15B is expressed in very small pustule size rather than complete absence of rust. The reaction progresses toward greater susceptibility with higher temperatures. Ramsey is resistant to bunt and loose smut.

Ramsey has good test weight and produces a satisfactory yield of semolina. Yellow pigment (carotenoid) content is high. Macaroni products made from Ramsey are satisfactory in color and in cooking properties.

History.—Ramsey (C.I. 13246; reg. 386) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. It is a selection from the cross Carleton × P.I. 94701, made in 1950. P.I. 94701 is a durum introduction from Palestine that was found to be resistant during the 1950 epidemic of 15B stem rust. The F_4 generation was grown in the greenhouse in the spring of 1952, and the F_5 in the field that summer. One of the F_5 rows selected became Ramsey. It was designated Ld 369 and was entered in the Uniform Spring Wheat Regional Performance Nursery in 1954. Seed was increased in the winter of 1954–55 in Arizona. Ramsey was released by the North Dakota Agricultural Experiment Station in 1956 (*54*).

Distribution.—Ramsey was grown on an estimated 266,461 acres in 1959, nearly all in North Dakota (*91*).

WELLS

Description.—Plant spring habit, early, short; stem white to light purple, strong; spike awned, oblong, dense, erect to inclined; glumes glabrous, yellow, long, midwide; shoulders narrow, elevated; beaks wide, acuminate, 3 to

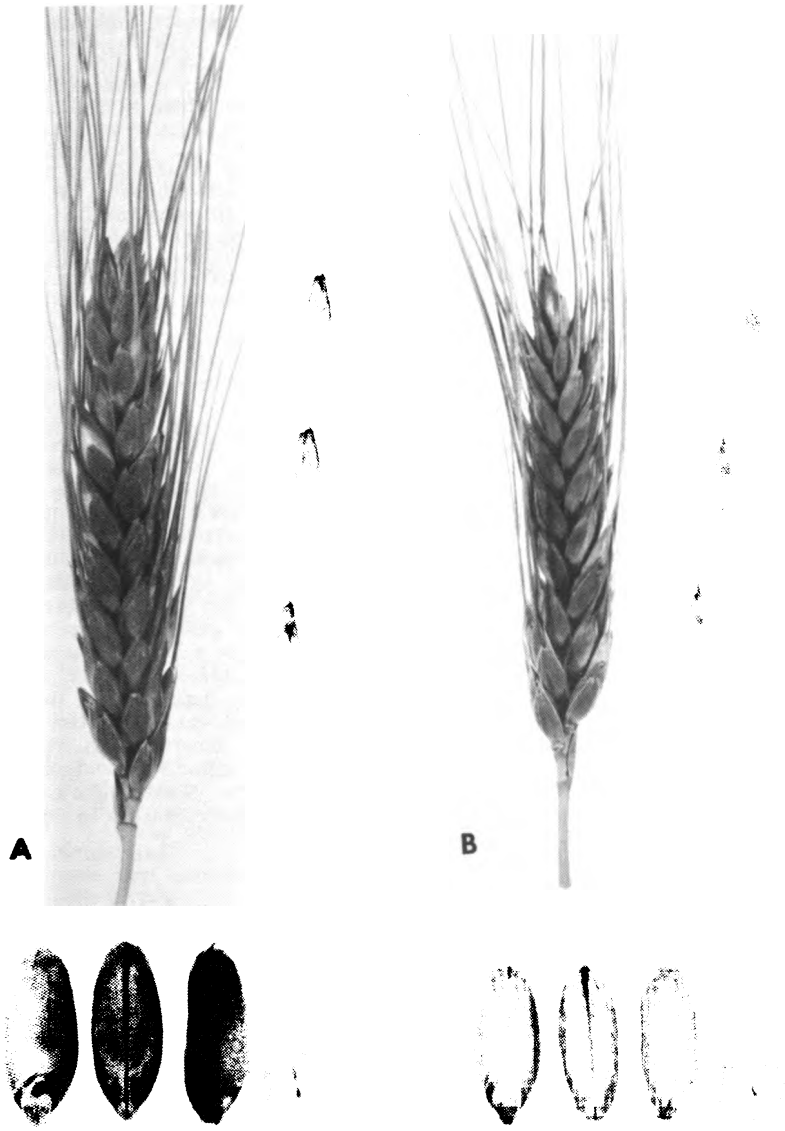

FIGURE 32.—*A*, Ramsey and *B*, Lakota durums: spikes and glumes, × 1; kernels, × 3.

5 mm. long (a few plants have beaks about 20 mm. long); awns white to yellow, 2 to 12 cm. long (slightly shorter than awns on Lakota); kernels white (amber), midlong, hard, elliptical; germ midsized; crease midwide, middeep to shallow; cheeks angular to rounded; brush small, short (essentially no brush).

Wells is resistant to leaf rust and to stem rust, including race 15B. Resistance to 15B is derived from Khapli emmer.

Wells is slightly lower in test weight than other commercial durum varieties, but higher than Lakota. In gluten strength Wells is rated as moderately weak. Yield of semolina is lower than that of Mindum grown under similar conditions. Color of macaroni products from Wells is excellent, averaging

higher than Mindum. It has good macaroni cooking properties.

Wells has smaller kernels than other commercial durums (except Lakota), but shape of the kernels is typical for a durum.

History.—Wells (C.I. 13333; reg. 403) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. Wells and Lakota were selections from the same cross, Sentry × (Ld 379–Ld 357), made in 1952. Varieties other than Sentry involved in the parentage were Mindum, Stewart, Heiti, Vernum, Khapli emmer, Nugget, and Carleton. In 1953 and 1954 five generations were advanced through use of the greenhouse. The most promising single plant lines, grown in F_5 rows in the field in 1954, were selected for preliminary seed increase and testing. Winter increases in California and Mexico facilitated yield testing at Fargo and Langdon by 1957. The selection later named Wells was designated as Ld 389 and was entered in the Uniform Spring Wheat Regional Performance Nursery in 1958. Wells was released by the North Dakota Agricultural Experiment Station in 1960 and recommended in Montana that same year (*76, 80*).

LAKOTA

Description.—Plant spring habit, early, short; stem white to light purple, strong; spike awned, oblong, dense, erect to inclined; glumes glabrous, yellow, long, narrow to midwide; shoulders narrow, elevated; beaks wide, acuminate, 5 to 15 mm. long (predominant length slightly longer than in Wells); awns white to yellow, 5 to 14 cm. long (longer awns than Wells); kernels white (amber), midlong, hard, elliptical; germ midsized; crease midwide, middeep to shallow; cheeks angular to rounded; brush midsized, short to midlong (longer brush than Wells). (See fig. 32, *B.*)

Lakota, like Wells, is resistant to leaf rust and to stem rust, including race 15B.

Lakota is lower in test weight than Wells and the other commercial durums. Semolina yield is equal to that of Mindum. It has excellent macaroni quality. Color score is high and it has strong gluten.

Lakota, like Wells, has a smaller kernel than is typical of other commercial durums, but kernel shape is similar.

History.—Lakota (C.I. 13335; reg. 402) was developed cooperatively by the North Dakota Agricultural Experiment Station and the Crops Research Division. It is a selection from the same cross as Wells and has the same developmental history. The selection which became Lakota was designated as Ld 392 and entered in the Uniform Spring Wheat Performance Nursery in 1958, along with Wells. Lakota was released by the North Dakota Agricultural Experiment Station in 1960 (*76*).

COMMON WHEAT

Common wheat is of either winter or spring habit. The culm of the plant usually is hollow, but occasionally is pithy within, and varies in strength and height. The blades of the leaves are usually narrower than those of the durum and poulard wheats.

Common wheat is distinguished from club wheat, which it most closely resembles, by a spike long in proportion to its thickness. The spike of common wheat is usually dorsally compressed and is thus wider when seen in face view than across the 2-rowed profile. The rachis is tough and does not disarticulate.

The spikelets are two- to five-flowered, far apart, only slightly overlapping, pressed close to the rachis, and nearly erect. The lemmas are awnless or have awns less than 10 cm. long. The palea is as long as the lemmas and remains entire at maturity.

The glumes generally are keeled only in the upper half, shorter than the lemmas, firm, and glabrous. (Some common wheats not included in this bulletin are pubescent.)

The kernels are free-threshing and may be either soft or hard, and white or red.

The characteristic of common wheat of greatest economic value is its well-known quality for

breadmaking, as common wheat excels all the other divisions of the genus in this respect. It is also the best known and most widely cultivated of all the species. The varieties are most nearly related to the club wheats (ssp. *compactum*). These two divisions have the same number of chromosomes and cross readily. There are intermediate types that resemble both common and club wheats.

Common wheat is adapted to widely varying climatic conditions and possesses more diverse characters than any of the other divisions. Ninety-one varieties cultivated in the United States are distinguished by the accompanying key.

KEY TO VARIETIES

1a. Spike awnless to awnleted.
2a. Glumes white.
3a. Kernels white.
Kernels short to midlong.
Kernels soft.
Winter habit, spike middense. Page
Spike fusiform to oblong, awnlets 5 to 15 mm. long--YORKWIN-- 63
Spike oblong, awnlets 2 to 10 mm. long---- ALBA (REDMOND)-- 63
Spike oblong to clavate, awnlets 3 to 5 mm. long---- BREVOR-- 64
Spring habit.
Spike middense to dense.
Spike oblong, awnless.
Kernels soft to semihard---------- IDAED 59-- 64
Spike dense.
Spike oblong, awnlets 2 to 12 mm. long---------- KENHI-- 65
Awnless---------- MARFED-- 66
Spike oblong to clavate.
Awnless---------- LEMHI 53-- 66
Kernels semihard.
Spring habit.
Spike middense to lax.
Spike oblong, awnless---------- WHITE FEDERATION 54-- 66
3b. Kernels red.
Kernels short to midlong.
Kernels soft.
Winter habit.
Spike fusiform.
Stem white.
Plant early.
Awnlets 5 to 40 mm. long, beaks 1.5 mm. long
WAKELAND-- 67
Awnlets 2 to 25 mm. long, beaks 0.5 mm. long.
Spike erect to inclined, plant short-------- MONON-- 67
Spike inclined, plant short to midtall-------- KNOX-- 68
KNOX 62-- 69
Plant midseason.
Awnlets 2 to 15 mm. long, beaks 0.5 mm. long.
Spike lax, inclined to nodding---------- VIGO-- 69
Spike middense, inclined.
Plant midseason to late---------- ACE-- 70
Spike middense, erect to inclined---------- REED-- 70
Stem purple.
Plant very early.
Awnlets 2 to 20 mm. long, beaks less than 0.5 mm. long
GEORGIA 1123-- 70
Plant early to midseason.
Awnlets 2 to 20 mm. long, beaks 0.5 to 1.0 mm. long
LAPORTE-- 71
Plant midseason.
Awnlets 2 to 25 mm. long, beaks less than 0.5 mm. long
LUCAS-- 72

KEY TO VARIETIES—Continued

1a. Spike awnless to awnleted—Continued
2a. Glumes white—Continued
3b. Kernels red—Continued
Kernels short to midlong—Continued
Kernels soft—Continued
Winter habit—Continued
Spike oblong.
Stem white.
Plant early. Page
Awnlets 2 to 10 mm. long, spike middense.. VERMILLION.. 72
Plant midseason.
Awnlets 5 to 15 mm. long, spike dense..... PENNOLL.. 74
Stem purple.
Plant midseason.
Awnlets 2 to 8 mm. long, beaks less than 0.5 mm. long..... DUAL.. 74
Spike oblong to fusiform.
Stem purple.
Plant midseason.
Awnlets 5 to 30 mm. long, beaks 0.5 mm. long.. REDCOAT.. 74
Stem white.
Plant midseason.
Awnlets 2 to 20 mm. long, beaks less than 0.5 mm. long..... TODD.. 75
Intermediate habit.
Spike fusiform, middense.
Stem white.
Plant very early.
Awnlets 2 to 10 mm. long, beaks 0.5 mm. long.. BLEDSOE.. 75
Stem purple.
Plant midseason.
Awnlets 2 to 20 mm. long, beaks less than 0.5 mm. long..... TAYLOR 49.. 76
Spike oblong to clavate, dense..... ATLAS 66.. 76
Kernels hard.
Winter habit.
Spike fusiform, lax.
Awnlets 2 to 15 mm. long, beaks 0.5 mm. long.
Stems semisolid to solid..... REGO.. 76
Spike oblong, middense.
Awnlets 2 to 40 mm. long, beaks 1.0 mm. long.. COLOROW.. 77
Spring habit.
Spike fusiform.
Spike middense to lax.
Stems semisolid to solid.
Awnlets 2 to 15 mm. long, beaks 1.0 mm. long..... SAWTANA.. 78
Awnlets 2 to 25 mm. long, beaks 0.5 to 1.0 mm. long..... CHINOOK.. 78
Awnlets 3 to 8 mm. long, beaks 0.5 mm. long.. RESCUE.. 79
Spike middense.
Glumes midlong.
Awnlets 3 to 10 mm. long, beaks 0.5 mm. long..... RUSHMORE.. 79
Awnlets 2 to 15 mm. long, beaks 0.5 mm. long..... PEMBINA.. 79
Awnlets 5 to 25 mm. long, beaks 0.5 to 1.0 mm. long..... THATCHER.. 80
CANTHATCH.. 81
Glumes long.
Awnlets 2 to 20 mm. long, beaks 1.0 mm. long..... SELKIRK.. 81
Spike oblong (slightly clavate).
Spike middense.
Glumes midlong, wide.
Awnlets 2 to 12 mm. long, beaks 0.5 to 1.0 mm. long..... JUSTIN.. 82

1a. Spike awnless to awnleted—Continued
2a. Glumes white—Continued
3b. Kernels red—Continued
Kernels long.
Kernels soft.
Winter habit.
Spike fusiform. Page
Awnlets 2 to 30 mm. long, beaks 0.5 mm. long--- TAYLAND-- 82
2b. Glumes brown.
3a. Kernels white.
Kernels short to midlong.
Kernels soft.
Winter habit.
Spike fusiform.
Awnlets 5 to 20 mm. long---------- CORNELL 595-- 82
Spike oblong.
Glumes midlong.
Awnlets 1 to 20 mm. long---------- GENESEE-- 83
Glumes long.
Awnlets 2 to 40 mm. long---------- AVON-- 83
Spring habit.
Spike oblong.
Awnlets 1 to 3 mm. long---------- FEDERATION 41-- 83
Kernels semihard.
Spring habit.
Spike fusiform to oblong.
Awnless---------- RAMONA 50-- 85
3b. Kernels red.
Kernels short to midlong.
Kernels soft.
Winter habit.
Spike fusiform.
Spike middense, nodding.
Awnlets 2 to 20 mm. long, beaks obtuse---------- KENT--- 85
Spike middense to lax, inclined.
Awnlets 2 to 35 mm. long, beaks acute---------- FRISCO-- 85
Spike oblong to fusiform.
Spike middense, inclined.
Awnlets 5 to 25 mm. long, beaks obtuse-------- THORNE-- 86
SENECA-- 86
Kernels semihard.
Spring habit.
Spike oblong to clavate.
Awnlets 2 to 12 mm. long---------- GASSER-- 86
Kernels long.
Kernels soft.
Intermediate habit.
Spike oblong, lax, nodding.
Awnlets 2 to 30 mm. long---------- ANDERSON-- 88
1b. Spike awned.
2a. Glumes white.
3a. Kernels white.
Kernels short to midlong.
Kernels soft.
Winter habit.
Spike middense to dense, inclined.
Beaks 2 to 4 mm. long---------- GAINES-- 88
Spring habit.
Spike dense, inclined.
Beaks 3 to 10 mm. long---------- ONAS 53-- 88
Kernels hard.
Winter habit.
Spike dense, erect to inclined.
Beaks 2 to 4 mm. long---------- BURT-- 90
Kernels long.
Kernels semihard.
Spring habit.
Spike middense, inclined.
Beaks 3 to 5 mm. long---------- BAART 46-- 90

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KEY TO VARIETIES—Continued

1b. Spike awned —Continued
2a. Glumes white—Continued
3b. Kernels red.
Kernels short to midlong.
Kernels hard.
Winter habit.
Spike fusiform.
Plant very early.
Glumes with black markings. Page
Beaks 3 to 12 mm. long---------- WICHITA-- 92
Plant early, short.
Beaks 2 to 5 mm. long, shoulders oblique to square- OMAHA-- 92
Beaks 3 to 5 mm. long, shoulders oblique to wanting PAWNEE-- 92
Beaks 5 to 15 mm. long, shoulders oblique to wanting PONCA-- 94
Plant early, short to midtall.
Beaks 2 to 4 mm. long---------- KAW-- 94
Glumes with black markings.
Beaks 5 to 15 mm. long---------- CROCKETT-- 96
Beaks 2 to 4 mm. long---------- BISON-- 96
Plant midseason.
Beaks 2 to 8 mm. long, shoulders narrow to wanting NEBRED-- 97
Beaks 1 to 3 mm. long, shoulders square to oblique WARRIOR-- 97
Glumes with black markings.
Beaks 1 to 4 mm. long---------- AZTEC-- 97
Spike fusiform to oblong.
Plant very early, short.
Beaks 2 to 5 mm. long, shoulders narrow to wanting TRIUMPH-- 99
Plant very early, short to midtall.
Beaks 5 to 15 mm. long, shoulders elevated to square SUPER TRIUMPH-- 100
Plant early, midtall.
Glumes with black markings.
Beaks 2 to 3 mm. long---------- KIOWA-- 100
Spike oblong (and oblong to fusiform).
Plant early to midseason.
Beaks 5 to 15 mm. long, shoulders oblique to square COMANCHE-- 101
Plant midseason.
Beaks 3 to 5 mm. long, shoulders rounded------- DELMAR-- 101
Beaks 2 to 5 mm. long, shoulders oblique to elevated CHEYENNE-- 101
TENDOY-- 103
SHOSHONI-- 103
Spring habit.
Spike fusiform (and fusiform to oblong).
Plant midseason.
Spike lax.
Beaks 3 to 5 mm. long, shoulders square to elevated LATHROP-- 103
Spike lax to middense.
Beaks 5 to 15 mm. long, shoulders elevated------- MIDA-- 103
Beaks 4 to 6 mm. long, shoulders square to elevated RUSSELL-- 105
Spike middense.
Beaks 2 to 10 mm. long, shoulders rounded to elevated CERES-- 105
Plant midseason to late.
Spike middense.
Beaks 4 to 8 mm. long, shoulders square to elevated CENTANA-- 105
Beaks 6 to 12 mm. long, shoulders elevated---- CONLEY-- 106

1b. Spike awned—Continued
2a. Glumes white—Continued
3b. Kernels red—Continued
Kernels short to midlong—Continued
Kernels hard—Continued
Spring habit—Continued
Spike oblong (and oblong to fusiform).
Plant early.
Stem white.
Beaks 3 to 10 mm. long, shoulders oblique to rounded — LEE — Page 106
Beaks 2 to 5 mm. long, shoulders narrow to wanting, oblique — MILAM — 108
Kernels long.
Kernels soft.
Winter habit.
Spike fusiform.
Plant midseason.
Beaks 2 to 5 mm. long, shoulders narrow to wanting, oblique — RACINE — 108
2b. Glumes brown.
3b. Kernels red.
Kernels short to midlong.
Kernels hard.
Winter habit.
Spike fusiform.
Plant early.
Beaks 4 to 8 mm. long — OTTAWA — 108
Plant early to midseason.
Beaks 5 to 12 mm. long — CONCHO — 110
Plant midseason.
Beaks acute, 0.5 to 1.0 mm. long — ITANA — 110
Beaks 3 to 5 mm. long — COLUMBIA — 110
Spike oblong to fusiform.
Plant early, short.
Beaks 2 to 4 mm. long — TASCOSA — 112
Plant early to midseason, midtall.
Beaks 3 to 8 mm. long — WESTMONT — 112
2c. Glumes white and glumes brown (mechanical mixture).
3b. Kernels red.
Kernels short to midlong.
Kernels hard.
Winter habit.
Spike fusiform — RODCO — 113

DESCRIPTION, HISTORY, AND DISTRIBUTION OF VARIETIES

YORKWIN

Description.—Plant winter habit, midseason, tall; stem white, midstrong; spike awnleted, fusiform to oblong, middense, inclined; glumes glabrous, white, short to midlong, midwide; shoulders midwide, oblique to square; beaks wide, obtuse, 0.5 mm. long; awnlets white, 5 to 15 mm. long; kernels white, midlong, soft, elliptical; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Yorkwin is susceptible to leaf rust, stem rust, loose smut, bunt, and dwarf bunt. It is resistant to soilborne mosaic and has some degree of tolerance to races of powdery mildew prevalent in New York. It is susceptible to hessian fly.

Yorkwin is considered to be a winter-hardy variety when grown in Michigan and New York.

Yorkwin produces a low-protein soft wheat flour, suitable for pastry purposes.

History.—Yorkwin (C.I. 11855; reg. 395) was selected from a cross between Dietz (Fulcaster) and Goldcoin, which was made at Ithaca, N.Y., in 1919. The final selection, designated as Cornell 254a1–101–19, was made in 1924. It was released by the New York (Cornell) Agricultural Experiment Station in 1935 (*56, 10*).

Distribution.—Yorkwin was grown on an estimated 181,585 acres in 1959, mostly in Michigan. Approximately 12,000 acres were grown in New York (*91*).

ALBA (REDMOND)

Description.—Plant winter habit, late, tall; stem white, coarse, strong; leaves pubescent; spike awnleted, oblong, middense, erect to inclined; glumes glabrous, white, long, wide; shoulders narrow,

square to rounded; beaks midwide, obtuse to acute, 1 mm. long; awnlets white, 2 to 10 mm. long; kernels white, short, soft, oval; germ midsized to large; crease midwide to wide, middeep; cheeks rounded; brush midsized, long.

Alba is susceptible to leaf and stem rust, bunt, and powdery mildew. It is resistant to stripe rust.

Alba has good soft wheat milling and baking quality.

Alba is moderately susceptible to shattering and only moderately winter hardy.

History.—Alba (C.I. 13256) was obtained in 1948 from Holland by the Buchanan-Cellers Grain Co., McMinnville, Oreg. The original lot of only 27 kernels was turned over to Mr. W. Redmond, McMinnville, for increase. He grew the 27 seeds in a flat and planted seed from them in a garden the next year. In 1952 some seed was distributed to other growers. It was sold under the name of Redmond by the Buchanan-Cellers Grain Co. (*1*). In 1955, the Oregon Agricultural Experiment Station sent a sample of seed to the Institute for Research on Field Crops, Wageningen, Holland. It was identified as Alba, a variety which had been grown in Holland since 1938. In 1955 it was grown on about 5 percent of the area sown to winter wheat in Holland.

Alba is a selection from the cross Trésor × Jacob Cats, and was developed in Belgium.

Distribution.—Alba was grown on an estimated 39,050 acres in 1959, almost all in Oregon (*91*).

Synonym.—Redmond.

BREVOR

Description.—Plant winter habit, midseason, short; stem white, very strong; spike awnleted, oblong to clavate, middense, erect to inclined; glumes glabrous, white, short to midlong, midwide; shoulders midwide, rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 3 to 5 mm. long; kernels white, midlong, soft, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 33, *A*.)

Brevor is susceptible to leaf and stem rust, and moderately resistant to stripe rust. It is resistant to nearly all races of bunt (moderately resistant to L–8 and similar races.) Brevor is susceptible to powdery mildew.

Brevor is similar to Burt, Elmar, and Omar in winter hardiness. All are less hardy than most Turkey type hard red winter wheats.

Brevor is only fair in milling quality. It is satisfactory for general purpose (family) flour and for cake flour (*121*).

History.—Brevor (C.I. 12385; reg. 374) was selection 1–3–11–5 from a cross made in 1938 between Brevon, a selection from a cross between (Turkey-Florence × Fortyfold-Federation), and an F_2 from the cross (Oro × Turkey-Florence) × (Oro × Fortyfold-Federation). Brevor was a selection from the cross Turkey-Florence × Fortyfold-Federation. Brevor was entered in the Western Uniform Winter Wheat Performance Nursery in 1947, and released in the fall of 1949 by the Washington Agricultural Experiment Station. It was developed cooperatively by the Washington Agricultural Experiment Station and the Crops Research Division (*10*).

Distribution.—Brevor was grown on an estimated 216,907 acres in 1959, mostly in Idaho and Washington. Small acreages were grown in Oregon and Utah (*91*).

IDAED 59

Description.—Plant spring habit, early, short; stem white, midstrong; spike awnless, oblong, middense to dense, erect; glumes glabrous, white, long, wide; shoulders narrow to midwide, oblique to square; beaks wide, obtuse, 0.5 mm. long; kernels white, short, soft to semihard, ovate; germ midsized; crease midwide to wide, middeep to deep; cheeks rounded; brush midsized, midlong.

Idaed 59 is resistant to the races of stem rust predominant in Idaho at the time of its release. It is moderately resistant to leaf rust and resistant to stripe rust. Idaed 59 is susceptible to bunt and resistant to races of powdery mildew in Idaho.

Idaed 59 has good milling characteristics. Limited tests indicate that it is a pastry-type soft white wheat useful as a cake flour at low and intermediate protein levels.

History.—Idaed 59 (C.I. 13631) was derived from the backcross (Illinois 1–Chinese[2] × *Triticum timopheevi*) × Idaed[5]. Selection was based on resistance to stem rust and the Idaed plant type. Mildew resistance of Idaed 59 is closely associated with its stem rust resistance. The original cross to Idaed was made in 1947 at Moscow, Idaho. Backcrosses to Idaed were made from 1948 to 1957. Screening for resistance to stem rust was begun at Sandpoint, Idaho, in 1949 and 1950, then at Aberdeen, Idaho, from 1950 to 1958, and once in Mexico in 1953. Increase was made in the winter of 1958–59 and again

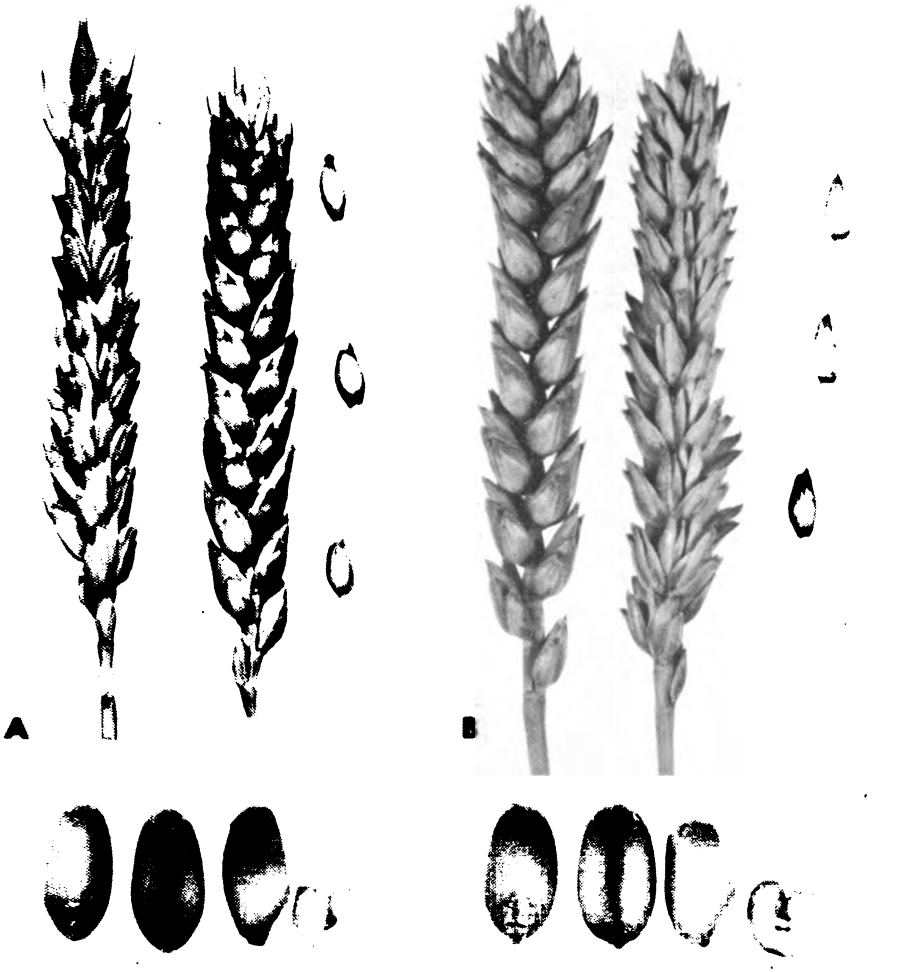

FIGURE 33.—*A*, Brevor and *B*, Lemhi 53 common wheats: spikes and glumes, × 1; kernels, × 3.

in the summer of 1959 from 20 rust-free F_3 rows in the Aberdeen 1958 stem rust nursery. Idaed 59–B, C.I. 13632, was increased in the greenhouse at Moscow, Idaho. The other 19 lines were increased in Mexico and the bulk designated as Idaed 59, C.I. 13631. Both were entered in the 1960 Western Uniform Spring Wheat Nursery. Head rows of Idaed 59 were grown and bulked in 1960 and entered in the 1961 Regional Nursery as Idaed 59–C, C.I. 13634. B and C lines were increased for distribution. Because they were very similar they were bulked and released as Idaed 59, and the original C.I. No. 13631 was used. Idaed 59 was released by the Idaho Agricultural Experiment Station in 1962.

KENHI

Description.—Plant spring habit, early (about 2 days later than Idaed), short; stem white, midstrong; spike awnleted, oblong, dense, inclined; glumes glabrous, white, long, midwide; shoulders midwide, rounded to square; beaks mid-

wide, obtuse, 0.5 mm. long; awnlets white, 2 to 12 mm. long; kernels white, short, soft, ovate; germ midsized to large; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Kenhi is moderately resistant to leaf rust and resistant to stem rust (including the race 15B complex present at time of release).

Quality of Kenhi has been assessed as generally satisfactory for pastry purposes, but tends to be slightly higher in protein than Lemhi and Lemhi 53.

History.—Kenhi (C.I. 13268) was developed at the University of Alberta, Edmonton, Canada, from a cross of Kenya 338AC_2E_3 × Lemhi.[2] The original cross was made in 1950. Selection for rust resistance was done in field nurseries during segregating and backcross generations. Lines resistant to leaf and stem rust under field conditions at Edmonton, Lethbridge, and Winnipeg were tested for yield and quality in 1955–57. Selection H–54–121 was licensed in Canada in 1958. It was developed primarily for growing under irrigation in southern Alberta (*19*).

MARFED

Description.—Plant spring habit, midseason, midtall; stem white, strong; spike awnless, oblong, dense, erect; glumes glabrous, white, short, midwide to wide; shoulders narrow to midwide, wanting to oblique; beaks midwide, acute, 0.5 mm. long; kernels white, short, soft, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Marfed is resistant to some races of bunt and is moderately resistant to mildew. It is susceptible to leaf rust and stem rust.

Although Marfed is a spring wheat, it is slightly more winter hardy than Federation and may be fall-sown in areas with mild winters. It performs better than Federation when planted in late spring (*122*).

Marfed has satisfactory test weight but some lots do not mill as well as Federation. It has slightly stronger gluten than Idaed and Federation, but is a pastry type soft wheat useful as a cake flour at low and intermediate protein levels.

History.—Marfed (C.I. 11919; reg. 376) was developed from a cross between a Marquis–Florence selection and Federation made in 1931. The selection which became Marfed, designated as Wash. 3348, was made in 1936. It was entered in the Uniform Spring Wheat Nursery in the western region in 1945, and released by the Washington Agricultural Experiment Station in 1947. Marfed was developed cooperatively by the Washington Agricultural Experiment Station and the Crops Research Division (*122*).

Distribution.—Marfed was grown on an estimated 101,918 acres in 1959, mostly in Washington. Some Marfed was grown in California and Oregon, and a very small acreage in Idaho and Utah (*91*).

LEMHI 53

Description.—Plant spring habit, early to midseason, short; stem white, strong; spike awnless, oblong to clavate, dense (lower ⅓ of head middense), erect to inclined; glumes glabrous, white, long, wide; shoulders midwide, oblique to rounded; beaks wide, obtuse, 0.5 mm. long; kernels white, short, soft, oval to ovate; germ midsized to large; crease wide, deep; cheeks rounded; brush midsized, midlong. (See fig. 33, *B.*)

Lemhi 53 is resistant to races 38 and 56 of stem rust but is susceptible to the 17–29 race complex. It is susceptible to leaf rust except for race 15. Lemhi 53 is susceptible to bunt and loose smut.

Lemhi 53 has satisfactory quality for pastry purposes.

History.—Lemhi 53 (C.I. 13258; reg. 380) was developed cooperatively by the Idaho Agricultural Experiment Station and the Crops Research Division. A Kenya selection, California 3098, resistant to several races of stem rust, was crossed to Lemhi in 1942. The cross and first backcross was made at Davis, Calif., and subsequent backcrosses were made at Aberdeen, Idaho. Final screenings for rust reaction and milling and baking quality were made in 1952. Sixteen Kenya × Lemhi[5] lines most nearly resembling Lemhi were bulked in 1953 to make Lemhi 53 (C.I. 13068). There were slight differences in plant height among these lines. This seed lot of Lemhi 53 was released by the Idaho Agricultural Experiment Station in 1953. Idaho substituted Kenya × Lemhi[6] lines (C.I. 13258) in 1957 for the Kenya × Lemhi[5] bulk (*56*).

Distribution.—The estimated acreage in 1959 was 277,854 acres, which includes Lemhi and Lemhi 53. Most of the acreage was in Idaho. Some was reported from Utah and Oregon, and minor acreages from Montana and Nevada (*91*).

WHITE FEDERATION 54

Description.—Plant spring habit, early, short; stem white, strong; spike awnless, oblong, middense to lax, erect; glumes glabrous, white, long, wide; shoulders wide, square; beaks midwide,

acute, less than 0.5 mm. long; kernels white, short to midlong, semihard, ovate; germ large; crease midwide, middeep; cheeks rounded; brush large to midsized, midlong.

White Federation 54 is resistant to the races of stem rust and bunt which were prevalent in California at the time it was released.

It is very similar to White Federation 38 except for added stem rust resistance. The Hope and Eureka types of resistance to stem rust are combined in this variety.

White Federation 54 is seldom milled, as it is primarily a feed wheat.

History.—White Federation 54 (C.I. 13361) was developed cooperatively by the California Agricultural Experiment Station and the Crops Research Division. White Federation 45 (Eureka × White Federation 38[5]) was obtained from the Waite Agricultural Research Institute, Adelaide, South Australia. Two additional backcrosses to White Federation 38 were made at the California Agricultural Experiment Station. A total of 232 F_4 lines were composited to produce White Federation 54, which is Eureka × White Federation 38[7]. The variety was released by the California Agricultural Experiment Station in 1955.

Distribution.—White Federation, White Federation 38, and White Federation 54 acreages were combined in the 1959 Wheat Variety Survey (*91*). They were grown on an estimated 92,940 acres, practically all in California.

WAKELAND

Description.—Plant winter habit, early, short to midtall; stem white, midstrong; spike awnleted, fusiform, middense, erect; glumes glabrous, white, midlong to long, midwide; shoulders midwide to wide, square to rounded; beaks narrow, obtuse, 1.5 mm. long; awnlets white, 5 to 40 mm. long; kernels red, midlong, soft, ovate to elliptical; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized to small, collar often visible, brush short. (See fig. 34, *A*.)

Wakeland is moderately resistant to leaf rust, susceptible to stem rust, moderately resistant to loose smut and powdery mildew, and susceptible to soilborne mosaic. It is susceptible to hessian fly.

Wakeland is a soft to semihard wheat suitable for use as general purpose (family) flour and when low in protein as pastry flour. Wakeland is not as high in protein as Atlas 66, but generally is higher than Chancellor.

History.—Wakeland (C.I. 13382) was a selection from the cross (Frondoso × Redhart 3-Noll 28) × Hardired. (Frondoso × Redhart 3-Noll 28), selection 5464, was one of a large number of lines selected in 1943 from material received from the Crops Research Division in 1942. Selection 5464 was crossed with Hardired. One of the selections from this cross, No. 3855, was entered in a preliminary test in the fall of 1948 and in advanced tests in 1949. It was entered in the Uniform Southern Soft Wheat Nursery in 1957, and released to certified seed growers by the North Carolina Agricultural Experiment Station in 1959.

MONON

Description.—Plant winter habit, early, short; spike awnleted, fusiform, middense, erect to inclined; glumes glabrous, white, midlong, midwide; shoulders narrow, oblique to rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 2 to 25 mm. long; kernels red, midlong, soft, ovate; germ small to midsized; crease midwide, middeep; cheeks rounded; brush small, midlong to short.

Monon is resistant to races of leaf rust which were prevalent in Indiana at the time it was released. This resistance was derived from Chinese (C.I. 6223). It is susceptible to stem rust but generally escapes severe damage because of early maturity. It is susceptible to loose smut and bunt, moderately susceptible to powdery mildew in the adult plant stage, and resistant to soilborne mosaic and to hessian fly. It possesses the H_3 H_3 gene pair for hessian fly resistance.

Monon is 2 to 3 inches shorter than Knox and matures about 1 day earlier. The variety is about equal to Vermillion in winter hardiness.

Monon has good soft wheat milling and baking quality.

History.—Monon (C.I. 13278) was a selection from a cross of a sib line of Knox with a disease and hessian fly resistant line, Purdue 4127A4–12–1. The objective, involving a series of complex crosses, was to combine yield, quality, hardiness, and leaf rust, powdery mildew, and hessian fly resistance in one early variety. The last cross was made in 1947. Parents involved in the Monon pedigree are Trumbull, Fultz Sel., Minhardi, Wabash, Purplestraw, Chinese, Michigan Amber, Kawvale, Hungarian, W38, Fairfield, Hope, and Hussar. The final selection was assigned the designation Purdue 4746A2–10–1–2–1 and entered in the Uniform Eastern Soft Wheat Nursery in 1956. Monon was

FIGURE 34.—*A*, Wakeland and *B*, Knox common wheats: spikes and glumes, × 1; kernels, × 3.

developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research and Entomology Research Divisions. It was released to certified seed growers in the fall of 1959 by the Purdue Agricultural Experiment Station.

KNOX

Description.—Plant winter habit, early, short to midtall; stem white (a few light purple), midstrong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, rounded to oblique; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 2 to 25 mm. long; kernels red, midlong, soft, ovate; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized, midlong to short. (See fig. 34, *B*.)

Knox, like Vermillion, is highly resistant to the races of leaf rust prevalent in Indiana when it was released. Leaf rust resistance is derived principally from Chinese (C.I. 6223). Knox

is susceptible to stem rust but generally escapes damage because of early maturity. Knox is susceptible to loose smut, bunt, and hessian fly. It is resistant to soilborne mosaic, and possesses some degree of adult plant resistance to powdery mildew.

Knox is not quite as winter hardy as Vermillion or Vigo.

Knox has good soft wheat milling and baking quality. It is one of the highest ranking soft red winter wheats in test weight.

History.—Knox (C.I. 12798; reg. 355) was derived from a series of 6 crosses involving 7 parents: Chinese, Michigan Amber, Purplestraw, Minhardi, Wabash, Fultz Sel. (C.I. 11512), and Trumbull. (Vermillion is a selection from the same series.) The first cross was made in 1927 and the last in 1941. Plant selections were made in the F_2 and F_4 generations. The final selection (in F_4) was made in 1945. Two hundred F_7 plants were selected from this line and the progenies grown in 1949. The majority of these were combined and increased in 1950. The final purified selection was designated as Purdue 414A29–4–8 and entered in the Uniform Eastern Soft Wheat Nursery in 1951. Knox was developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research Division. It was released to certified seed growers by the Purdue Agricultural Experiment Station in the fall of 1953 (*18*).

Distribution.—Knox was the leading soft red winter wheat variety in the United States in 1959. It was grown on 1,753,280 acres, principally in Indiana, Illinois, Missouri, and Ohio. Smaller acreages were grown in southern Michigan, North Carolina, South Carolina, Kentucky, Tennessee, Arkansas, Mississippi, and North Central Texas (*91*).

KNOX 62

Description.—Knox 62 is indistinguishable from Knox. The two varieties are essentially alike in yield, winter hardiness, and milling and baking quality. Knox 62 possesses high resistance to hessian fly, while Knox is susceptible. Knox 62 may not be as susceptible to loose smut as is Knox. Degree of infection through artificial inoculation is lower than in Knox, and under limited observations the increase by natural infection has not been as rapid as in Knox.

History.—Knox 62 (C.I. 13701) was developed by the Purdue Agricultural Experiment Station and the Crops Research and Entomology Research Divisions. Knox 62 is the progeny from one F_3 plant of the backcross Knox[5] × (Purdue 4781A7–26–2 × Purdue 4126A9–16–1–1–3) F_1. Purdue 4718A7–26–2 is a hessian fly resistant soft red winter wheat derived from a fly-resistant durum wheat, P.I. 94587. Purdue 4126A9–16–1–1–3 was derived from a composite cross designed to bring together smut resistance from Hope–Hussar and Kawvale. Parents involved in Knox 62 are Fultz selection, Hungarian, durum P.I. 94587, Fairfield, Knox, Hope, Hussar, Trumbull, W38, Wabash, and Kawvale. The progenies from 16 F_4 plants from Purdue 551G3–1–16 were combined to produce the breeders' seed stock for multiplication. Knox 62 was entered in the Uniform Eastern Soft Wheat Nursery in 1961 and released to certified seed growers by the Purdue Agricultural Experiment Station in 1962. It was recommended as a replacement for Knox.

VIGO

Description.—Plant winter habit, midseason, tall; stem white, midstrong; spike awnleted, fusiform, lax, inclined to nodding; glumes glabrous, white, long, narrow to midwide; shoulders midwide, square to rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 3 to 15 mm. long; kernels red, midlong, soft, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush small, short.

Vigo was resistant to races of leaf rust prevalent in Indiana at the time of release, but is susceptible to some races that have since become important. It is susceptible to stem rust, powdery mildew, bunt, and hessian fly. It is resistant to soilborne mosaic and to some races of loose smut.

Vigo has a tendency to shatter under dry harvest conditions and is sufficiently winter hardy for growing in Indiana and nearby States.

Vigo has good soft wheat milling and baking quality.

History.—Vigo (C.I. 12220; reg. 358) was developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research Division. It was selected from a cross made in 1931 between Fultz Sel. (C.I. 11512), a sister selection of Wabash, and Trumbull. The line later named Vigo was selected in 1937 and designated as Purdue 3241–15. It was entered in the Uniform Eastern Soft Wheat Nursery in 1943 and released by the Purdue Agricultural Experiment Station in 1946 (*10*).

Distribution.—Vigo was grown on an estimated 226,419 acres in 1959, princi-

pally in Missouri, Ohio, Kentucky, and Indiana (*91*); it has been largely replaced since 1954 when it was grown on 1,820,003 acres (*97*).

ACE

Description.—Plant winter habit, midseason to late, short to midtall; stem white, midstrong to strong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, rounded to oblique; beaks wide, obtuse, 0.5 mm. long; awnlets white, 2 to 15 mm. long; kernels red, midlong, soft, ovate; germ midsized; crease wide, middeep to deep; cheeks angular to rounded; brush midsized to small, midlong.

Ace is resistant to those races of leaf rust prevalent in the Southeast at the time it was released, but is susceptible to stem rust. It is moderately resistant to loose smut and to powdery mildew. Ace is resistant to soilborne mosaic and to hessian fly.

Ace is a winter-hardy variety when grown under Arkansas conditions.

Ace is low in test weight, moderate in protein level, and soft to semihard in kernel texture. The grain is suitable for general purpose (family) flour and, when low in protein, for pastry flour.

History.—Ace (C.I. 13384) was developed by the Arkansas Agricultural Experiment Station from an F_4 population received from the Crops Research Division. Parents involved were W38, Illinois 1, Hope, Purplestraw, Leap, Thatcher, Trumbull, Red Wonder, Steinwedel, Chancellor, and *Triticum timopheevi.* A selection designated as T 1123–3, was made in 1944, and a reselection from T 1123–3 known as T 1123–3–20, was made in 1954. This line was entered in the Uniform Southern Soft Wheat Nursery in 1958, and released by the Arkansas Agricultural Experiment Station in 1960 (*94*).

REED

Description.—Plant winter habit, midseason, short to midtall; stem white (sometimes purple tinged), strong; spike awnleted, fusiform, middense, erect to inclined; glumes glabrous, white, midlong, midwide; shoulders wide, square; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 3 to 15 mm. long; kernels red, midlong, soft, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush large, midlong. (See fig. 35 *A.*)

Reed is moderately susceptible to stem rust, and resistant to those races of leaf rust prevalent at the time of release. It is susceptible to loose smut but has shown less infection than Dual. Reed is susceptible to mildew and is resistant to soilborne mosaic (an occasional plant will rosette, however). It is hessian fly resistant (same source of resistance as in Dual and Monon). Reed is slightly less winter hardy than Dual.

Reed is much superior in test weight to Dual. It has good soft wheat milling and baking quality.

History.—Reed (C.I. 13513) was developed by the Purdue Agricultural Experiment Station and the Crops Research and Entomology Research Divisions. Reed was selected from a cross made in 1945 involving a very strong-strawed high-yielding line and a hessian fly resistant line. The final selection, Purdue 4521A6–8–10–2, was made in the F_7 generation in 1951. Parents involved in the complex cross include Hope, Hussar, Trumbull, Fultz selection, Hungarian, W38, Wabash, Fairfield, Kawvale, and American Banner. Purdue 4521A6–8–10 (C.I. 13290) was grown in the Uniform Eastern Soft Wheat Nursery from 1957 through 1959. Reed, selected from it, was grown in the Regional Nursery from 1960 through 1962. Breeders' seed was increased from a composite of 98 uniform head rows grown in 1957. Reed was released to certified seed growers by the Purdue Agricultural Experiment Station in the fall of 1962. It was recommended as a replacement for Dual.

GEORGIA 1123

Description.—Plant winter habit, very early, short to midtall; stem purple, midstrong to strong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, midlong to long, midwide; shoulders narrow, oblique to square; beaks midwide, obtuse, less than 0.5 mm. long; awnlets white, 2 to 20 mm. long; kernels red, short to midlong, soft, ovate; germ midsized to large; crease midwide, shallow; cheeks rounded to angular; brush midsized, long. (See fig. 35, *B.*)

Georgia 1123 is resistant to those races of leaf rust prevalent in the Southeast at the time of release and to soilborne mosaic. It is susceptible to powdery mildew, stem rust, and to loose smut. It is resistant to hessian fly.

Georgia 1123 is a soft to semihard wheat suitable for general purpose (family) flour and, when low in protein, for pastry flour.

History.—Georgia 1123 (C.I. 13292) was developed by the Georgia Agricultural Experiment Station from F_6 material received in 1948 from the Crops

FIGURE 35.—*A*, Reed and *B*, Georgia 1123 common wheats: spikes and glumes, × 1; kernels, × 3.

Research Division. Parents involved are W38, Illinois 1, Hope, Purplestraw, Thatcher, Leap, Trumbull, Red Wonder, Steinwedel, *Triticum timopheevi*, and Chancellor. Several selections were made at Experiment, Ga., in 1950 and then tested for hessian fly resistance by the Entomology Research Division. The line designated as FW 1123-x-37, later named Georgia 1123, was found to be resistant. Georgia 1123 was grown in the Uniform Hessian Fly Nursery and Uniform Wheat Mildew Nursery, and was entered in the Uniform Southern Soft Wheat Nursery in 1959. It was released in 1959 by the Georgia Agricultural Experiment Station.

LAPORTE

Description.—Plant winter habit, early to midseason, midtall to tall; stem purple, midstrong; spike awnleted, fusiform to slightly clavate at tip, middense, inclined to nodding; glumes glabrous, white, midlong, midwide; shoulders midwide, rounded to oblique; beaks midwide, obtuse to acute, 0.5 to

1.0 mm. long; awnlets white, 2 to 20 mm. long; kernels red, midlong, soft, ovate; germ midsized to large; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

LaPorte is moderately resistant to leaf rust and soilborne mosaic. It is resistant to those cultures of powdery mildew which were prevalent in Indiana at the time of release. It is susceptible to stem rust, bunt, and hessian fly. It is highly resistant to loose smut, including those Trumbull attacking races that had become of critical importance when LaPorte was released.

LaPorte approaches Vigo and Vermillion in winter hardiness.

LaPorte has good soft wheat milling and baking quality and high test weight.

History.—LaPorte (C.I. 12557; reg. 356) resulted from a series of 5 crosses, combining characteristics from 6 original parents: Hope, Hussar, Trumbull, Fulhio, Purkof, and Fultz Sel. (C.I. 11845). The first cross was made in 1923 and the final one in 1939. Pedigree selections were made in each generation from the F_2 through the F_5. The final selection, Purdue A399A2–2–2–2–6, was entered in the Uniform Eastern Soft Wheat Nursery in 1948 and released to certified seed growers by the Purdue Agricultural Experiment Station in the fall of 1957. LaPorte was developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research Division (*35*).

Distribution.—Although seed was not available to farmers before 1958, 26,054 acres of LaPorte were reported grown in 1959, principally in Indiana (*91*).

LUCAS

Description.—Plant winter habit, midseason, midtall; stem purple, midstrong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, long, midwide to wide; shoulders midwide, oblique to rounded; beaks midwide, obtuse, less than 0.5 mm. long; awnlets white, 2 to 25 mm. long; kernels red, short to midlong, soft, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Lucas is susceptible to leaf and stem rust, loose smut, and hessian fly. It is moderately resistant to soilborne mosaic.

Lucas is winter hardy and well adapted to growing in Ohio and neighboring States.

Lucas produces grain of high test weight and of satisfactory soft wheat quality.

History.—Lucas (C.I. 12990; reg. 393) was developed by the Ohio Agricultural Experiment Station from a cross between OSU 101–3 × Thorne, made in 1938. Both parents originated from Portage × Fulcaster. The line which became Lucas was selected at Wooster, Ohio, from a bulk hybrid population in 1943. It was first tested in advanced rod rows in 1948 and in drill plot tests in 1951. It was entered in the Uniform Eastern Soft Wheat Nursery in 1952 under the Ohio number TN 1259. Lucas was released to certified seed growers in the fall of 1959.

VERMILLION

Description.—Plant winter habit, early, short to midtall; stem white, midstrong; spike awnleted, oblong, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, square to rounded; beaks midwide, obtuse, 0.5 mm. long (slightly longer than those of Dual); awnlets white, 2 to 10 mm. long; kernels red, midlong, soft, ovate; germ midsized; crease midwide, middeep to shallow; cheeks rounded; brush midsized, midlong to short. (See fig. 36, *A*.)

Vermillion, like Knox, is highly resistant to the races of leaf rust prevalent in Indiana when it was released. This resistance is derived from the variety Chinese (C.I. 6223). Vermillion is susceptible to stem rust but generally escapes damage because of early maturity. It is susceptible to loose smut, but less so than Knox. Vermillion is susceptible to powdery mildew, bunt, and hessian fly. It is resistant to soilborne mosaic.

Vermillion is more winter hardy than Knox and is exceptional in performance under conditions of delayed planting. Vermillion tends to head and ripen 1 or 2 days later than Knox.

Vermillion has good soft wheat milling and baking quality. It produces grain of high test weight, although generally a little lower than Knox.

History.—Vermillion (C.I. 13080; reg. 357) is derived from a series of six crosses involving seven parents: Chinese, Michigan Amber, Purplestraw, Minhardi, Wabash, Fultz Sel. (C.I. 11512), and Trumbull. (Knox is a selection from the same series.) The first cross was made in 1927 and the final one in 1941. Plant selections were made in the F_2 and F_3 generations, the latter in 1944. Two hundred F_7 plant progeny rows were grown from Purdue 414A9–2–3 in 1949. The majority of these progenies were combined to increase the variety in 1950, and C.I. No. 12748 was assigned. This seed lot comprised the initial release. In the meantime, a line of Purdue 414A9–2–3, typical of the variety,

FIGURE 36.—*A*, Vermillion and *B*, Redcoat common wheats: spikes and glumes, × 1; kernels, × 3.

was selected from the F_6 generation in 1948, and designated as C.I. 13080. Seed from this line was increased as foundation seed to replace the less uniform lot originally released. Vermillion (C.I. 12748) was entered in the Uniform Eastern Soft Wheat Nursery in 1950, and Vermillion (C.I. 13080) (Purdue 414A9–2–3–23) was entered in 1953, at which time the former was dropped. Vermillion was developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research Division. It was released to certified seed growers by the Purdue Agricultural Experiment Station in the fall of 1955 (*18*).

Distribution.—Vermillion was grown on an estimated 684,084 acres in 1959,

principally in Indiana, Ohio, Illinois, and Missouri. Minor acreages were grown in southern Michigan, Kentucky, Tennessee, and northwestern Arkansas (*91*).

PENNOLL

Description.—Plant winter habit, midseason, tall; stem white, midstrong; spike awnleted, oblong, dense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, oblique to rounded; beaks wide, obtuse, 0.5 mm. long; awnlets white, 5 to 15 mm. long; kernels red, midlong, soft, ovate; germ midsized to large; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Pennoll is susceptible to leaf rust and stem rust. It is resistant to bunt and moderately resistant to loose smut. It is susceptible to powdery mildew, soilborne mosaic, and hessian fly.

Pennoll is winter hardy when grown as far north as Pennsylvania.

Pennoll is a good quality soft wheat variety.

History.—Pennoll (C.I. 12755; reg. 381) was developed by the Pennsylvania Agricultural Experiment Station. It was selected from the cross Valprize × Nittany, which was made in 1933. The final selection was made in 1939 and designated Pa. 114A–42. It was entered in the Uniform Eastern Soft Wheat Nursery in 1949 and released by the Pennsylvania Agricultural Experiment Station in 1951 (*10, 56*).

Distribution.—Pennoll was grown on an estimated 370,247 acres in 1959, mostly in Pennsylvania. Smaller acreages were grown in Ohio, New Jersey, Maryland, New York, Delaware, and Virginia (*91*).

DUAL

Description.—Plant winter habit, midseason, short to midtall; stem purple, midstrong; spike awnleted, oblong, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide to wide, square to rounded; beaks midwide, obtuse, less than 0.5 mm. long; awnlets white, 2 to 8 cm. long; kernels red, midlong, soft, ovate; germ midsized to large; crease midwide, middeep; cheeks rounded; brush small, midlong to short.

Dual is resistant to races of leaf rust that were prevalent in Indiana at the time of release. Leaf rust resistance of Dual is of composite origin and is of the mature plant type. It is more resistant than any of the parent varieties. Dual is moderately susceptible to stem rust, susceptible to loose smut and bunt, and moderately resistant in the adult plant stage to powdery mildew. In Indiana it has been resistant to soilborne mosaic but occasional plants in Illinois tests have shown rosette symptoms. Dual possesses the H_3 H_3 gene pair for resistance to hessian fly, derived from the W38 parent, and it was the first hessian fly resistant wheat adapted to the Eastern Soft Wheat Region. The name Dual was chosen to designate it as a dual-purpose variety. It produces high yields of grain and may be seeded before the hessian fly free date for pasture or forage.

Dual has a level of winter hardiness similar to that of Vigo. It possesses good soft wheat milling and baking properties, but tends to be low in test weight.

History.—Dual (C.I. 13083; reg. 354) resulted from a series of seven crosses designed to combine desirable characteristics from eight original parents: Fultz Sel. C.I. 11512, Hungarian, Hope, Hussar, W38, Trumbull, Wabash, and Fairfield. The first cross was made in 1923 and the last in 1940. Plant selections were made in the F_2, F_3, F_5, and F_8 generations. The final one, made in 1948, was designated as Purdue 40149A4–9–3–5–113, and was entered in the Uniform Eastern Soft Wheat Nursery in 1953. Dual was developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research and Entomology Research Divisions. It was released to certified seed growers by the Purdue Agricultural Experiment Station in the fall of 1955 (*17*).

Distribution.—Dual was grown on an estimated 693,442 acres in 1959, mainly in Indiana, Ohio, Illinois, southern Michigan, and Pennsylvania (*91*).

REDCOAT

Description.—Plant winter habit, midseason, midtall; stem purple, very strong; spike awnleted, oblong to fusiform, middense to lax, erect to inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, rounded to square; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 5 to 30 mm. long; kernels red, midlong, soft, ovate; germ large to midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 36, B.)

Redcoat is resistant to the races of leaf rust that were prevalent in the Eastern Soft Wheat Region at the time of release. It is resistant in the mature plant stage to many races of stem rust. It is moderately susceptible to loose smut, has adult plant resistance to powdery mildew, is resistant to soil-

borne mosaic and to hessian fly. It is susceptible to dwarf bunt.

Redcoat has very strong straw and is particularly suited for growing in the Eastern Soft Wheat Region under conditions of high fertility or where lodging has been a problem. Redcoat is about as winter hardy as Knox. It has a tendency to shatter under dry harvest conditions.

Redcoat produces grain of satisfactory soft wheat quality.

History.—Redcoat (C.I. 13170) was produced from a series of nine crosses. The first was made in 1929 and the last in 1945. Parents involved were: Fultz, Hungarian, W38, Fairfield, Kawvale, Hope, Hussar, Trumbull, Surpresa, and Fultz selection (C.I. 11845). The final selection, which was multiplied as Redcoat, Purdue 4548A2–5–18, was made in the F_7 generation, in 1951. It was entered in the Uniform Eastern Soft Wheat Nursery in 1955. Redcoat was developed cooperatively by the Purdue Agricultural Experiment Station and the Crops Research and Entomology Research Divisions. It was released to certified seed growers in the fall of 1960 by the Purdue, Pennsylvania, and New York (Cornell) Agricultural Experiment Stations (*16*).

TODD

Description.—Plant winter habit, midseason, midtall; stem white, midstrong; spike awnleted, oblong to fusiform, middense, erect to inclined; glumes glabrous, white, midlong to long, midwide; shoulders midwide, rounded to oblique; beaks midwide, obtuse, less than 0.5 mm. long; awnlets white, 2 to 20 mm. long; kernels red, short to midlong, soft, ovate; germ large; crease wide, middeep to deep; cheeks rounded to angular; brush midsized, midlong.

Todd is resistant to some races of leaf and stem rust, but is susceptible to leaf rust races now predominant in the Eastern Soft Wheat Region. It is resistant to loose smut, soilborne mosaic, powdery mildew, and hessian fly.

Todd is considered to be winter hardy.

Todd is lower in test weight than is desired but has satisfactory milling and baking properties. It is particularly soft in kernel texture.

History.—Todd (C.I. 13110) was developed by the Kentucky Agricultural Experiment Station from a bulk hybrid obtained from the Indiana Agricultural Experiment Station. The pedigree included Kawvale, W38, Fultz selection, Hungarian, Wabash, Fairfield, Trumbull, Hope, and Hussar. A selection made in 1948 from the F_8 generation bulk hybrid resulted in Todd. It was tested as Ky 50–9929 and was entered in the Uniform Eastern Soft Wheat Nursery in 1954. Todd was released to certified seed growers in 1956 by the Kentucky Agricultural Experiment Station.

Distribution.—Todd was grown on an estimated 16,089 acres in 1959, mostly in Missouri and Kentucky. Very small acreages were grown in Ohio, Michigan, Illinois, Pennsylvania, Tennessee, and West Virginia (*91*).

BLEDSOE

Description.—Plant spring intermediate habit, very early, tall; stem white, midstrong; spike awnleted, fusiform, middense, erect to inclined; glumes glabrous, white, midlong to long, midwide; shoulders midwide, square to rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 2 to 10 mm. long; kernels red, short to midlong, soft, ovate; germ small to midsized; crease wide to midwide, middeep; cheeks angular to rounded; brush midsized, midlong.

Bledsoe is resistant to some races of stem rust and is resistant to the races of leaf rust that were predominant in the Southeast at the time of release. It is susceptible to loose smut, moderately resistant to powdery mildew, resistant to soilborne mosaic, and susceptible to hessian fly.

Bledsoe is not a winter-hardy variety but can be grown in most of Georgia.

Bledsoe generally is higher in protein than Chancellor and has a slightly harder kernel texture. Grain of Bledsoe is suited for general purpose (family) flour and for pastry flour if the protein content is low.

History.—Bledsoe (C.I. 13238; reg. 359) was selected at the Georgia Agricultural Experiment Station from F_5 or F_6 material obtained in 1948 from the Crops Research Division. Lines selected in 1949 and 1950 from row FW 701 were outstanding in yield. One was designated FW 701–x–31 and later named Bledsoe. Parents involved in the pedigree were Frondoso, Redhart 3, Noll 28, Purplestraw, Steinwedel, *Triticum timopheevi*, W38, Illinois 1, and Hope. Bledsoe was entered in the Uniform Southern Soft Wheat Nursery in 1955 and released by the Georgia Agricultural Experiment Station in 1956.

Distribution.—Bledsoe was grown on an estimated 47,735 acres in 1959, more than half of which were in Georgia. Other States having 2,000 acres or more of Bledsoe were Louisiana, Alabama, Mississippi, and Arkansas (*91*).

TAYLOR 49

Description.—Plant spring intermediate habit, midseason, midtall; stem purple, midstrong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, long, midwide to wide; shoulders midwide to wide, rounded to square; beaks wide, obtuse, less than 0.5 mm. long; awnlets white, 2 to 20 mm. long; kernels red, midlong, soft, ovate; germ midsized; crease wide, middeep; cheeks angular; brush midsized, midlong.

Taylor 49 is susceptible to stem rust. It is resistant to the races of leaf rust prevalent at the time Taylor was released (1953), but is susceptible to some races which have become widespread in the Eastern United States since that time. Taylor 49 is moderately resistant to loose smut, resistant to soilborne mosaic, highly susceptible to powdery mildew, and susceptible to hessian fly.

Taylor 49 is sufficiently winter hardy to be grown in the Southeast.

Taylor 49 is essentially identical to Taylor (C.I. 12461) except that Taylor 49 is resistant to soilborne mosaic, while Taylor is susceptible, and Taylor 49 is 1 to 2 days later in maturity than Taylor.

Taylor 49 has satisfactory soft wheat quality.

History.—Taylor 49 (C.I. 13249; reg. 373) was selected in 1948 from Y2375 (later named Taylor). The selection was made by the Crops Research Division, at Beltsville, Md. It was grown in North Carolina on mosaic infested soil from 1951 through 1954. Head selections were made from the lines. Resistant head rows were saved and seed bulked for increase of Taylor 49. The new variety was released to certified seed growers by the North Carolina Agricultural Experiment Station in 1956.

Distribution.—Taylor 49 was grown on an estimated 14,460 acres in 1959, principally in South Carolina, North Carolina, Arkansas, Virginia, and Maryland (*91*).

ATLAS 66

Description.—Plant spring intermediate habit, midseason, short to midtall; stem white, midstrong; spike awnleted, oblong to clavate, dense, erect; glumes glabrous, white, midlong, midwide; shoulders wanting to narrow, rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 3 to 10 mm. long; kernels red, midlong, soft, elliptical; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 37, *A*.)

Atlas 66 is moderately resistant to leaf rust, resistant to some races of stem rust, and susceptible to loose smut, soilborne mosaic, and hessian fly. It is moderately resistant to powdery mildew.

It is not sufficiently winter hardy to be grown north of a line drawn from Tennessee through northern Virginia.

Atlas 66 is consistently higher in protein content than other soft wheat varieties grown in the Southeast. It is used in milling general purpose (family) flour and in some cases has been blended with hard red winter wheat for production of (bread) bakery flour.

History.—Atlas 66 (C.I. 12561; reg. 353) was selected from the cross Frondoso × (Redhart 3 × Noll 28), which was made in 1936 by the Crops Research Division. F_4 seed was sent to North Carolina in 1940 and the final selection was made in 1942 at the North Carolina Agricultural Experiment Station. Atlas 66 was tested as N.C. 5466 and was entered in the Uniform Southern Soft Wheat Nursery in 1948. It was released by the North Carolina Agricultural Experiment Station in the same year (*56*).

Distribution.—Atlas 66 was grown on an estimated 210,434 acres in 1959, almost half of which were in North Carolina. Other States that grew 5,000 acres or more of Atlas 66 were Louisiana, Virginia, South Carolina, Arkansas, and Mississippi (*91*).

REGO

Description.—Plant winter habit, midseason, tall; stem white, semisolid to solid, weak; spike awnleted, fusiform, lax, inclined to nodding; glumes glabrous, white, midlong, midwide; shoulders narrow, oblique to rounded; beaks midwide, acute to obtuse, 0.5 mm. long; awnlets white, 2 to 15 mm. long; kernels red, midlong, hard, ovate; germ midsized to small; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Rego has solid stems and is resistant to the wheatstem sawfly. It is susceptible to stem rust and leaf rust. It has some resistance to loose smut and is resistant to some races of bunt. Rego is resistant to stripe rust.

Rego is a moderately winter-hardy variety and is particularly adapted to north-central Montana.

Rego has hard wheat quality characteristics similar to Turkey, and superior to Karmont.

History.—Rego (C.I. 13181) was developed cooperatively by the Montana Agricultural Experiment Station and the Crops Research and Entomology

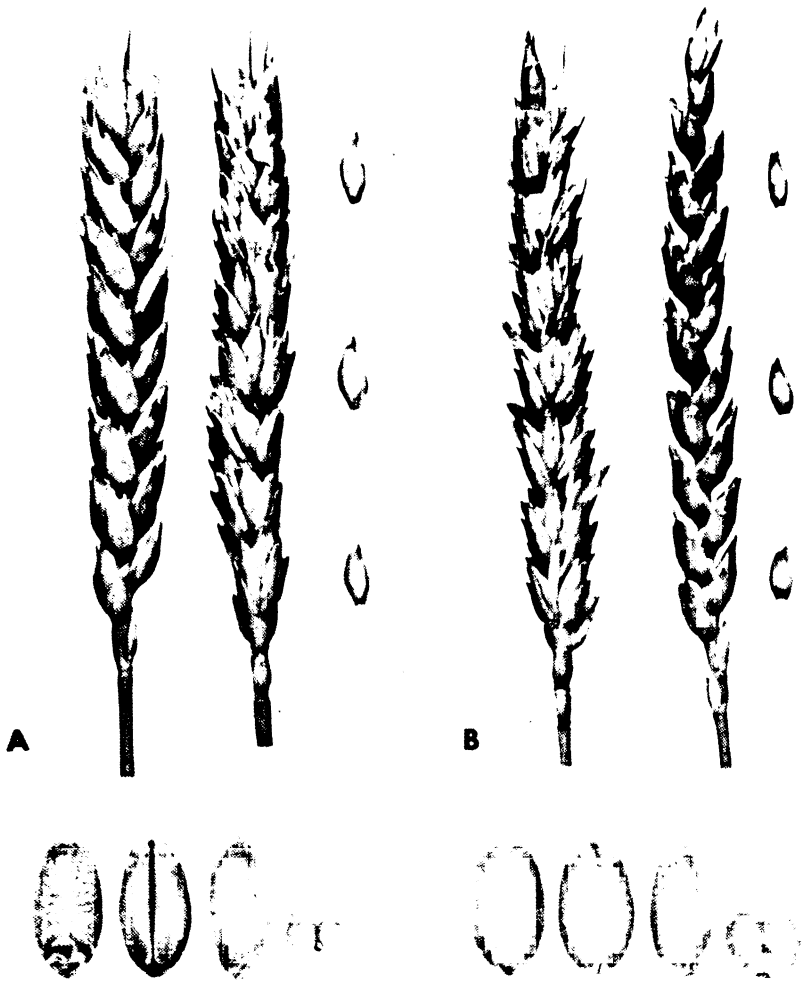

FIGURE 37.—*A*, Atlas 66 and *B*, Rescue common wheats: spikes and glumes, × 1; kernels, × 3.

Research Divisions. It was selected from the cross Yogo × Rescue. The cross was made at the Montana Agricultural Experiment Station in 1946. The F_2 through F_4 populations were selected for sawfly resistance and winter hardiness. Reselection within these lines followed and Montana 56–28 (later named Rego) was a composite of four F_5 lines. Rego was released by the Montana Agricultural Experiment Station in 1956.

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Distribution.—Rego was grown on an estimated 9,454 acres in 1959, all in Montana (*91*).

COLOROW

Description.—Plant winter habit, midseason, midtall; stem white, strong; spike awnleted, oblong, middense, erect; glumes glabrous, white, midlong, midwide; shoulders wide, rounded to elevated; beaks midwide, acute, 1.0 mm.

long; awnlets white, 2 to 40 mm. long; kernels red, short, hard, ovate; germ small; crease midwide, shallow; cheeks rounded; brush midsized to large, midlong.

Colorow is resistant to leaf rust but susceptible to stem rust. It is resistant to the races of common and dwarf bunt that were predominant in western Colorado at the time of release. It is particularly adapted to the dwarf bunt area of western Colorado.

Colorow has good milling and baking characteristics, equal to those of Cheyenne.

History.—Colorow (C.I. 12865; reg. 399) is a selection from the cross Marquillo - Oro × Oro - Turkey - Florence, which was made at the Kansas Agricultural Experiment Station, Manhattan, in 1940. The F_2 generation was grown at Manhattan, Kans., in the bunt nursery. The F_3 generation was divided, part going to Colorado and part to Nebraska. From the F_3 progenies grown at Fort Collins, Colo., in 1943, the line that became Colorow was selected and sent back to Manhattan in 1944. The F_4 and F_5 selections were grown at Manhattan and the F_6 and F_7 at Fort Collins. In the fall of 1947 selection 54–59–11–3–2–2 (along with others) was sent to Nebraska and grown at North Platte. It was advanced to single plots at Lincoln in 1949 and assigned the number NP48505. The selection was grown in the Uniform Hard Red Winter Wheat Bunt Nursery from 1951 to 1953 and had an outstanding record for resistance to common and dwarf bunt. Colorow was developed in cooperation with the Crops Research Division, and released by the Colorado Agricultural Experiment Station in 1960 (*56*).

SAWTANA

Description.—Plant spring habit, midseason to late, tall; stem white, weak, semisolid to solid; spike awnleted, fusiform, middense to lax, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, square; beaks midwide, obtuse to acute, 1.0 mm. long; awnlets white, 2 to 15 mm. long; kernels red, short, hard, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong, collared.

Sawtana is susceptible to leaf rust and stem rust. It is moderately resistant to bunt, and resistant to loose smut. Sawtana is resistant to wheat stem sawfly. It has solid-stemmed straw and tends to lodge.

Sawtana is similar to Rescue in milling and baking quality. It tends to be lower in test weight than Rescue but higher in flour yield. It produces bread of satisfactory loaf volume.

History.—Sawtana (C.I. 13304) was selected from the cross Rescue × (Mida-Cadet). The cross was made at Swift Current, Saskatchewan in the winter of 1946–47. F_1 seed was planted at Swift Current in 1947. The F_2 generation was grown in California in bulk during the winter of 1947–48. F_3 seed from the bulk was grown at Langdon, N. Dak., in 1948. F_6 seed of 10 selections was sent to the Montana Agricultural Experiment Station in 1951. One of the 10 was designated as B51–9 and entered in the Uniform Spring Wheat Sawfly Yield Nursery in 1954. This selection was released as Sawtana in 1961 by the Montana Agricultural Experiment Station, in cooperation with the Crops Research and Entomology Research Divisions.

CHINOOK

Description.—Plant spring habit, early, short; stem white, midstrong, semisolid to solid; spike awnleted, fusiform, middense to lax, inclined; glumes glabrous, white, midlong to long, midwide; shoulders midwide, square to rounded; beaks midwide to wide, obtuse to acute, 0.5 to 1.0 mm. long; awnlets white, 2 to 25 mm. long; kernels red, short, hard, oval; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong.

Chinook is susceptible to leaf rust and resistant to several races of stem rust. It is susceptible, however, to stem rust race 15B. It is susceptible to bunt and loose smut. Chinook is resistant to wheat stem sawfly and has some degree of drought tolerance.

Chinook is equal to Marquis in milling and baking characteristics.

History.—Chinook (C.I. 13220) was developed from a cross of Thatcher × S–615–11, made at the Cereal Division Laboratory, Ottawa, Canada, in 1938. S–615–11 was a sawfly resistant line that was susceptible to diseases in general and of poor bread-baking quality. Early generation material was grown at the Dominion Experiment Station, Swift Current, Saskatchewan. Testing was conducted by the Laboratory of Cereal Breeding at Lethbridge, Alberta, under the designation H–4258. Chinook was an F_7 selection made in 1943. It was licensed for sale in Canada in 1952 (*19*).

Distribution.—Chinook was grown on an estimated 300,598 acres in 1959, in Montana and North Dakota (*91*).

RESCUE

Description.—Plant spring habit, midseason to late, tall; stem white, weak, semisolid to solid; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, square to rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 3 to 8 mm. long; kernels red, short, hard, ovate; germ small; crease narrow, shallow; cheeks rounded; brush small, short. (See fig. 37, *B.*)

Rescue is susceptible to leaf rust, stem rust, bunt, and loose smut. It is resistant to the wheat stem sawfly.

Rescue often is low in protein and is characterized by low water absorption of the flour. It does not measure up to Thatcher, for example, in bread-baking quality, although loaf volume is good for the protein content. Flour made from Rescue tends to be somewhat yellow, resembling that of Thatcher.

History.—Rescue (C.I. 12435; reg. 384) was developed at the Dominion Experiment Station, Swift Current, Saskatchewan, Canada, from a cross between Apex and S–615 made at Ottawa in 1938. It resulted from a bulked F_5 line grown in 1941. It was selected for resistance to wheat stem sawfly and has solid stems like the S–615 parent, which was introduced from New Zealand. The selection was tested as Swift Current No. 4188. Rescue was licensed in Canada in 1946. Two bushels of seed obtained by the Montana Agricultural Experiment Station in the fall of 1944 was increased in Montana during the growing season and in Arizona during the winter months for 2 years. Seed of Rescue was available to farmers in Montana in 1947 (*10*, *19*).

Distribution.—Rescue is grown in the sawfly infested areas of Montana and northwestern North Dakota. It was grown on an estimated 484,940 acres in 1959, mostly in Montana (*91*).

RUSHMORE

Description.—Plant spring habit, early, short to midtall; stem purple, strong; spike awnleted, fusiform, middense, erect; glumes glabrous, white, midlong, midwide to wide; shoulders midwide, rounded to square; beaks midwide, acute, 0.5 mm. long; awnlets white, 3 to 10 mm. long; kernels red, short to midlong, hard, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Rushmore appears to have the Hope-type of reaction (moderately resistant) to leaf rust, loose smut, and bunt. It is resistant to many races of stem rust, but not to 15B. It has shown some tolerance to the 15B race complex (*56*).

Rushmore equals or exceeds Thatcher in milling and baking characteristics. It tends to be higher than Thatcher in test weight, flour yield, wheat protein, and crumb color. Flour from Rushmore usually is low in ash content.

History.—Rushmore (C.I. 12273; reg. 366) was developed by the South Dakota Agricultural Experiment Station from a cross of Rival × Thatcher made in 1937. The selection, S. Dak. 2280, was entered in the Uniform Spring Wheat Regional Performance Nursery in 1942. Rushmore was released by the South Dakota Agricultural Experiment Station in 1949 (*49*).

Distribution.—Rushmore was grown on an estimated 442,235 acres in 1959, mostly in South Dakota and North Dakota (*91*).

PEMBINA

Description.—Plant spring habit, early, short to midtall; stem white, strong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white, midlong, narrow to midwide; shoulders midwide, square to elevated; beaks narrow, acute, 0.5 mm. long; awnlets white, 2 to 15 mm. long; kernels red, short, hard, ovate; germ small; crease midwide, shallow; cheeks rounded; brush midsized, midlong.

Pembina is more resistant than Selkirk to 15B stem rust, and is moderately resistant to leaf rust. It is moderately susceptible to bunt and resistant to loose smut.

The outstanding feature of Pembina is its strong gluten. Milling characteristics of Pembina are slightly better than those of Selkirk. It produces good break flour yield but the loaf volume is not as high as expected for its protein content.

Pembina tends to lodge and shatter more than Selkirk.

History.—Pembina (C.I. 13332) was developed by the Rust Area Project Group, Canada Department of Agriculture Research Station, Winnipeg, Manitoba, Canada. It was selected from the cross, made in 1948, of Thatcher × (McMurachy-Exchange × Redman[3]). The latter part of the pedigree, McMurachy-Exchange-Redman[3], represents a sister selection of Selkirk. Pembina resulted from a bulked F_4 line grown in 1951. Pembina was entered in the Uniform Spring Wheat Regional Performance Nursery in 1959, and tested as C.T. 229. It was licensed for sale in Canada in 1959 (*19*).

THATCHER

Description.—Plant spring habit, early to midseason, short to midtall; stem white, midstrong; spike awnleted, fusiform, middense, erect to inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, square to rounded with a few elevated; beaks narrow, obtuse to acute, 0.5 to 1.0 mm. long; awnlets white, 5 to 20 mm. long; kernels red, short, hard, ovate; germ midsized; crease midwide, middeep; cheeks angular; brush midsized to large, midlong. (See fig. 38, *A*.)

Thatcher is susceptible to leaf rust and resistant to many races of stem rust, but not to 15B. It is susceptible to bunt, and resistant to loose smut.

Thatcher has a tendency to be low

FIGURE 38.—*A*, Thatcher and *B*, Selkirk common wheats: spikes and glumes, × 1; kernels, × 3.

in test weight but this is not generally reflected in its flour yielding capacity. It has comparatively high water absorption and high baking strength, but loaf crumb color is somewhat more yellow than most other hard red spring varieties. Dough from Thatcher flour tends to be "bucky" and is not as soft and pliable as dough from Marquis.

History.—Thatcher (C.I. 10003; reg. 277) was developed cooperatively by the Minnesota Agricultural Experiment Station and the Crops Research Division. It was selected from a double cross involving Marquis-Iumillo × Marquis-Kanred. The final cross was made in 1921. The line destined to become Thatcher was selected in 1925, and was tested in field plots beginning with 1929. It was released in 1934 by the Minnesota Agricultural Experiment Station, and approved for distribution in Canada in 1937. Thatcher was resistant to stem rust in the severe epidemics of 1935 and 1937, and the acreage increased rapidly in the United States and Canada. With the advent of 15B stem rust in 1950, the acreage sown to Thatcher declined (*8, 10*).

Distribution.—Thatcher was grown on an estimated 950,930 acres in 1959, mostly in Montana. Some Thatcher was grown in western North Dakota, out of the usual rust area. Small acreages were grown in South Dakota and Minnesota (*91*).

CANTHATCH

Description.—Plant spring habit, early to midseason, short to midtall; stem white, midstrong; spike awnleted, fusiform, middense, erect to inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, square to rounded; beaks midwide, obtuse to acute, 0.5 to 1.0 mm. long; awnlets white, 5 to 25 mm. long; kernels red, short, hard, oval to ovate; germ midsized; crease midwide, middeep; cheeks angular; brush midsized to large, midlong.

Canthatch is susceptible to leaf rust and resistant to isolates of stem rust races 11 and 15B to which Thatcher is susceptible. It is susceptible to bunt and resistant to loose smut.

Two favorable properties of Canthatch are strong gluten and excellent crumb structure of the bread. It is slightly higher than Thatcher in test weight and protein content. Canthatch mills satisfactorily, but the flour and bread crumb color is somewhat yellower than many other hard red spring varieties.

Canthatch and Thatcher are so similar they can be accurately distinguished only through differential tests with races of stem rust.

History.—Canthatch (C.I. 13345) was developed by the Rust Area Project Group, Canada Department of Agriculture Research Station, Winnipeg, Canada. It was a selection from Thatcher[6] × Kenya Farmer. The cross was made in 1951 and the last backcross in 1953. Canthatch was entered in the Uniform Spring Wheat Regional Performance Nursery in 1958 and tested as C.T. 233. It was licensed for sale in Canada in 1959.

SELKIRK

Description.—Plant spring habit, early to midseason, short to midtall; stem white, strong; spike awnleted, fusiform, middense, erect to inclined; glumes glabrous, white, long, midwide; shoulders midwide, oblique to square; beaks midwide, acute, 1.0 mm. long; awnlets white, 2 to 20 mm. long; kernels red, midlong, hard, ovate; germ midsized to large; crease midwide, middeep; cheeks angular; brush midsized, midlong to long. (See fig. 38, *B.*)

Selkirk is moderately resistant to leaf rust. It is resistant to stem rust, including isolates of race 15B that were prevalent at the time of release, but since then other isolates of race 15B have been noted which are virulent on Selkirk. The variety is resistant to bunt and loose smut, and to some cultures of powdery mildew.

Selkirk is similar to Lee in milling and baking quality, but tends to be lower in test weight and higher in flour yield. It generally is slightly lower in protein content than Lee, but a little higher in loaf volume. Dough handling properties are good.

History.—Selkirk (C.I. 13100; reg. 398) was developed by the Rust Area Project Group, Canada Department of Agriculture Research Station, Winnipeg, Canada. The cross McMurachy × Exchange was made in 1939, and this in turn was crossed to Redman in 1944. Backcrosses were made in 1945 and 1946. The complete pedigree of Selkirk is (McMurachy × Exchange) × Redman.[3] The line was designated as C.T. 186 and was entered in the Uniform Spring Wheat Regional Performance Nursery in 1953. It was licensed for sale in Canada in 1953, and released by North Dakota and Minnesota in 1955 (*19, 111*).

Distribution.—Selkirk was the leading hard red spring wheat variety in the United States in 1959. It was grown on 5,752,058 acres. Over half of that acreage was in North Dakota. Significant acreages of Selkirk were grown in Minnesota, South Dakota, and Montana (*91*).

JUSTIN

Description.—Plant spring habit, midseason, midtall; stem white, strong; spike awnleted, oblong (slightly clavate), middense, erect to inclined; glumes glabrous, white, midlong, wide; shoulders wide, rounded; beaks midwide, obtuse, 0.5 to 1 mm. long; awnlets white, 2 to 12 mm. long; kernels red, short, hard, ovate with truncate tip; germ large; crease wide, deep; cheeks angular; brush large, midlong.

Justin is moderately resistant to leaf rust. It is resistant to those races of stem rust which were prevalent at the time of release, including 15B. Justin is moderately resistant to loose smut and bunt, and resistant to "black chaff."

Justin is similar to Conley in quality in that it has excellent milling and baking characteristics. It has a long mixing time and good mixing tolerance.

History.—Justin (C.I. 13462) was developed by the North Dakota Agricultural Experiment Station and the Crops Research Division. It was selected from the cross [(Thatcher × Kenya Farmer) × (Lee × Mida)] × Conley. Material from the Thatcher × Kenya Farmer cross was received from the Crops Research Division and a selection made which was designated ND 4. This line was crossed with Ns. 3880.227, a selection from Lee × Mida. A high-yielding, late-maturing, vigorous segregate (ND 40) was crossed with Conley in 1954. The line which became Justin was selected in 1956 from F_5 head rows. Justin was entered in the Uniform Hard Red Spring Wheat Performance Nursery in 1959 as ND 102, selection A–3–14–1–1. It was released by the North Dakota Agricultural Experiment Station in 1962.

TAYLAND

Description.—Plant winter intermediate habit, midseason, midtall; stem white, midstrong; spike awnleted, fusiform, middense, inclined; glumes glabrous, white (light tan) with light-brown edges, long, midwide; shoulders midwide, square to elevated; beaks midwide, obtuse, 0.5 mm. long; awnlets white (or light tan), 2 to 30 mm. long; kernels red, long, soft, ovate to elliptical; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong to short.

Tayland is resistant to the races of leaf rust that were prevalent in Maryland at the time of release, but is susceptible to races which have since become established. It is susceptible to stem rust, powdery mildew, soilborne mosaic, and hessian fly. It is moderately resistant to loose smut.

Tayland regularly outyielded the leading wheats in Maryland—Thorne and Leapland—in prerelease trials. It is well adapted to central and eastern Maryland but is not sufficiently winter hardy for growing farther north.

Tayland has satisfactory soft wheat milling and baking properties.

History.—Tayland (C.I. 12761) originated from a cross of Leapland × Fronteira, made by the Crops Research Division, at Arlington Farm, Rosslyn, Va. Selection continued at Beltsville, Md. Several selections were sent to the Maryland Agricultural Experiment Station, College Park, Md., in 1945. One of these, designated Y2381, was further selected and entered in the Uniform Southern Soft Wheat Nursery in 1950. It was released by the Maryland Agricultural Experiment Station in 1954.

Distribution.—Tayland was grown on an estimated 53,400 acres in 1959, mostly in Maryland. Tayland was second only to Thorne in acreage in Maryland (*91*).

CORNELL 595

Description.—Plant winter habit, midseason, midtall; stem purple, midstrong; spike awnleted, fusiform, lax, erect; glumes glabrous, brown, midlong, midwide; shoulders narrow to wanting, rounded; beaks narrow to midwide, obtuse, 0.5 mm. long; awnlets white (light brown), 5 to 20 mm. long; kernels white, midlong, soft, ovate; germ midsized; crease midwide, deep; cheeks angular; brush midsized, midlong.

Cornell 595 is susceptible to leaf rust, stem rust, common and dwarf bunt, and hessian fly. It is resistant to soilborne mosaic and moderately resistant to loose smut. Cornell 595 has some degree of tolerance to races of powdery mildew in New York.

Cornell 595 is sufficiently winter hardy to be grown in New York and Michigan, and in Ontario, Canada.

Cornell 595 is a low protein soft wheat similar to Genesee and Yorkwin. It produces a suitable quality pastry flour.

History.—Cornell 595 (C.I. 12372; reg. 390) was selected from the cross (Honor–Forward × Nured) × Honor which was made at Ithaca, N.Y., in 1933. The F_1 involving Honor and Forward was crossed with Nured, and the F_1 of this combination was backcrossed to Honor. The final selection was made in 1937. The variety was released by the New York (Cornell) Agricultural Experiment Station as Cornell 595 in 1942 (*10, 56*).

Distribution.—Cornell 595 was grown on an estimated 106,329 acres in 1959,

nearly ¾ in Michigan and approximately ¼ in New York (*91*).

GENESEE

Description.—Plant winter habit, midseason, midtall; stem white, strong; spike awnleted, oblong, middense, erect; glumes glabrous, brown, midlong, midwide; shoulders midwide, square; beaks midwide, obtuse, 0.5 mm. long; awnlets white (light brown), 1 to 20 mm. long; kernels white, short to midlong, soft, ovate; germ midsized to large; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Genesee is susceptible to stem rust, leaf rust, common and dwarf bunt, and hessian fly. It is moderately resistant to soilborne mosaic and loose smut. Genesee has some degree of tolerance to powdery mildew races in New York.

Genesee is a winter-hardy variety when grown in the Northeastern United States and Ontario, Canada.

Genesee is a low protein soft wheat, well suited for pastry flour.

History.—Genesee (C.I. 12653; reg. 391) was selected from the cross Yorkwin × (Honor^2 × Forward), which was made at Ithaca, N.Y., in 1937. The final selection was made in 1941. During the testing period it was designated as Cornell 828a1–2–3. It was entered in the Uniform Eastern Soft Wheat Nursery in 1949. Genesee was released by the New York (Cornell) Agricultural Experiment Station in 1951 (*10, 56*).

Distribution.—Genesee was the leading white wheat in the Eastern United States in 1959. It was grown on 1,003,400 acres. About three-quarters of this acreage was in Michigan and most of the rest was in New York (*91*).

AVON

Description.—Plant winter habit, midseason, midtall; stem white, midstrong; spike awnleted, oblong, often clavate, dense, inclined; glumes glabrous, brown, long, midwide; shoulders wide, rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white to light brown, 2 to 40 mm. long; kernels white, midlong, soft, ovate; germ midsized to large; crease midwide, middeep; cheeks rounded; brush midsized, midlong to long. (See fig. 39, *A*.)

Avon is susceptible to leaf rust and stem rust. It is resistant to loose smut, common bunt, and dwarf bunt in New York. It has some degree of tolerance to races of powdery mildew prevalent in New York and is moderately resistant to soilborne mosaic. It is susceptible to hessian fly.

Avon averages about 2 inches shorter than Genesee and has slightly stiffer straw. Yield records are about the same.

Avon has slightly higher test weight and is similar to Genesee in milling and baking characteristics.

History.—Avon (C.I. 13477; reg. 389) was developed by the New York (Cornell) Agricultural Experiment Station. It was selected from the cross Genesee × [(Honor^2-Rosen rye × Hussar-Yorkwin) × Nured] made at Ithaca, N.Y., in 1948. The (Honor × Rosen rye) × Honor cross was made about 1925. Hussar was crossed with Yorkwin in 1937 and an F_1 crossed with Honor^2 × Rosen rye in 1940. This produced a bunt resistant selection which in turn was crossed with Nured in 1947. An F_1 of that series was crossed with Genesee in 1948. The selection from the last cross which became Avon was assigned the designation Cornell 4848aB–2B–59. It was grown in New York yield tests for 5 years and was tested for quality 3 years prior to release. Testing of Avon for disease resistance began in 1955. It was inoculated with common bunt and grown in a special nursery, and also grown in dwarf bunt infested soil. The first loose smut inoculations were conducted in 1957. Avon was first grown in the Uniform Eastern Soft Wheat Nursery in 1959, but sister selections had been entered since 1957. Avon was released by the New York (Cornell) Agricultural Experiment Station in 1958 (*63*).

FEDERATION 41

Description.—Plant spring habit, early to midseason, short to midtall; stem white, strong; spike apically awnleted, oblong, dense, erect; glumes glabrous, brown, short, wide; shoulders wide, oblique to square; beaks narrow, acute, 0.5 mm. long; awnlets white (light brown), 1 to 3 mm. long; kernels white, short, soft, ovate; germ midsized; crease narrow, shallow; cheeks rounded; brush midsized, midlong.

Federation 41 is susceptible to leaf and stem rust, and to powdery mildew. It is resistant to some races of bunt.

Federation 41 is very similar to Federation except for its resistance to several races of bunt. Although a spring variety, it is sufficiently winter hardy for fall planting in mild climates.

Federation 41 has good soft wheat milling and baking quality.

History.—Federation 41 (C.I. 12230) was developed by compositing 130 F_3 bunt resistant lines grown in 1941 from the backcross (Martin × White Federa-

FIGURE 39.—*A*, Avon and *B*, Ramona 50 common wheats: spikes and glumes, × 1; kernels, × 3.

tion[3]) × Federation[6]. It was released in 1942 by the California Agricultural Experiment Station. Federation 41 was developed cooperatively by the California Agricultural Experiment Station and the Crops Research Division (*10*).

Distribution.—Federation 41 was grown on an estimated 132,813 acres in 1959 in Idaho, Oregon, Washington, Nevada, and Utah. Federation and Federation 41 were not separated in the 1959 Wheat Variety Survey (*91*).

RAMONA 50

Description.—Plant spring habit, very early, short; stem white, midstrong; spike awnless, fusiform to oblong, middense to lax, erect to inclined; glumes glabrous, brown, long, wide; shoulders wide, square; beaks midwide, obtuse, less than 0.5 mm. long; kernels white, midlong, semihard, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 39 *B*.)

Ramona 50 is resistant to some races of bunt, leaf rust, stem rust, and powdery mildew. It is susceptible to stripe rust.

Ramona 50 seldom shatters. It tillers poorly so generally is sown at a higher rate than other commercial varieties. It does well under comparatively low rainfall conditions but is a poor competitor with weeds (*84*). Ramona 50 is about 3 days later than Ramona but the two are very similar in morphologic characters.

Ramona 50 may be used for bread and family flour when the protein level is 12 percent or above. The variety is also used for breakfast cereal (*84*). It has more desirable milling characteristics than does Onas 53.

History.—Ramona 50 (C.I. 12390) was developed cooperatively by the California Agricultural Experiment Station and the Crops Research Division. Fifty-six of the original 126 lines composited to make Romona 44 were backcrossed twice to Ramona 44 (a bunt resistant composite) and the progenies selected for rust resistance. A total of 62 F_8 lines were composited in 1950 and increased. The pedigree of Ramona 50 is [(Martin × Hard Federation[3]) × Ramona[6]] × Ramona 44[2] (*84*).

Ramona was released by the California Agricultural Experiment Station in 1951.

Distribution.—Ramona was grown on an estimated 270,649 acres in 1959, in California and Arizona, with a small acreage in Idaho. Ramona, Ramona 44, and Ramona 50 acreages were combined in the 1959 Wheat Variety Survey (*91*).

Synonyms.—Ramona 44 has the same C.I. number and is now considered a synonym. Although Ramona 50 was released as a more stem rust resistant form, subsequent tests show no difference between the two.[3]

KENT

Description.—Plant winter habit, midseason, midtall to tall; stem purple, midstrong; spike awnleted, fusiform, middense, nodding; glumes glabrous, light brown, long, midwide; shoulders narrow, oblique; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 2 to 20 mm. long; kernels red, midlong, soft to semihard, ovate; germ midsized; crease wide, deep to middeep; cheeks angular; brush midsized, midlong to long.

Kent is resistant to the predominant races of leaf rust, stem rust, bunt, loose smut, and mildew in Ontario and New York.

Kent is acceptable for pastry flour. Protein content generally is about 2 percent higher than in the soft white wheats Genesee and Avon.

History.—Kent (C.I. 13394) originated at the Ontario Agricultural College, Guelph, Ontario, Canada from the cross (Trumbull × Hope-Hussar) × Dawson. The cross was made in 1943. The selection identified as GC 361 was made in 1946. It was reselected in 1955 because of segregation for white and red seed color, and licensed in Canada in 1957 (*19*).

Distribution.—Kent was grown on a very small acreage in New York in 1959 (*91*).

FRISCO

Description.—Plant winter habit, early, midtall; stem purple, midstrong; spike awnleted, fusiform, middense to lax, inclined; glumes glabrous, brown, long, midwide; shoulders narrow to midwide, oblique; beaks midwide, acute, 0.5 mm. long; awnlets white (light tan), 2 to 35 mm. long; kernels red, midlong, soft to semihard, elliptical to oviate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized to small, short.

Frisco is highly resistant to the races of leaf rust that were prevalent in north-central Texas at the time of release. It is susceptible to race 15B of stem rust, but resistant to some other races. It is moderately resistant to bunt and susceptible to loose smut.

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[3] Private communication from C. A. Suneson dated April 3, 1959.

Frisco has a tendency to shatter. It is sufficiently winter hardy to be grown in north-central Texas.

The kernels are not the usual soft red winter type, but are rather long, slender, and somewhat harder in texture. The variety is suitable for general purpose (family type) flour.

History.—Frisco (C.I. 13106; reg. 350) was developed from a cross between Fronteira, an introduction from Brazil, and a pure line selection of Red May (C.I. 12023). The F_1, made in 1938, was backcrossed to the Red May parent in 1939. The line 131–46–3, later named Frisco, was selected in 1946 and released in 1953 to certified seed growers. Frisco was developed cooperatively by the Texas Agricultural Experiment Station and the Crops Research Division.

Distribution.—Frisco was grown on an estimated 6,340 acres in 1959, almost entirely in north-central Texas (*91*).

THORNE

Description.—Plant winter habit, midseason, midtall; stem faint purple, midstrong; spike awnleted, oblong to fusiform, middense, inclined; glumes glabrous, brown, midlong, midwide; shoulders midwide, oblique; beaks wide, obtuse, less than 0.5 mm. long; awnlets white (light brown), 5 to 25 mm. long; kernels red, midlong, soft, ovate to elliptical; germ midsized; crease midwide, middeep; cheeks angular; brush midsized, midlong.

Thorne is susceptible to leaf and stem rust, powdery mildew, and hessian fly. It is resistant to soilborne mosaic and moderately resistant to loose smut.

Thorne is sufficiently winter hardy to be grown in the northern part of the Eastern Soft Wheat Region.

Thorne has good soft wheat milling and baking quality but tends to be low in test weight.

History.—Thorne (C.I. 11856; reg. 323) was developed from a cross between Portage and Fulcaster, made at Columbus, Ohio, in 1917. The line that became Thorne was selected from a bulk population grown at Wooster, Ohio, in 1922. It was designated as Ohio TN 1006. It was reselected in 1936 and increased under the name of Thorne. The variety was released to certified seed growers by the Ohio Agricultural Experiment Station in the fall of 1937 (*10*).

Thorne was first grown in the Uniform Eastern Soft Wheat Nursery in 1939, one year after the Regional Performance Nursery had been established.

Distribution.—Thorne was grown on an estimated 641,684 acres in 1959, mainly in Ohio, Pennsylvania, Maryland, Virginia, and North Carolina. Smaller acreages were grown in southern Michigan, Indiana, Illinois, Kentucky, and Tennessee (*91*).

SENECA

Description.—Seneca is very similar to Thorne. It has higher test weight, a slightly higher yield, and slightly stiffer straw. Its milling and baking characteristics are also very similar to Thorne. (See fig. 40, *A*.)

History.—Seneca (C.I. 12529; reg. 362) is a sister selection of Thorne. It was designated as Ohio TN 1016–4 and after several years of testing was entered in the Uniform Eastern Soft Wheat Nursery in 1947. Seneca was increased in 1949 and released by the Ohio Agricultural Experiment Station in the fall of 1950.

Distribution.—Seneca was grown on an estimated area of 1,176,400 acres in 1959. Most of the Seneca was grown in Ohio, where it was the leading variety. Some acreage was also grown in Michigan, Indiana, Illinois, Tennessee, Pennsylvania, New Jersey, Virginia, and North Carolina (*91*).

GASSER

Description.—Plant spring habit, early, midtall; stem white, midstrong; spike awnleted, oblong to clavate, middense to lax, inclined; glumes glabrous, brown, long, narrow; shoulders narrow, square to elevated; beaks midwide, obtuse to acute, 0.5 mm. long; awnlets white to light brown, 2 to 12 mm. long; kernels red, short, semihard, ovate; germ large; crease wide, deep; cheeks angular; brush large, midlong.

Gasser is susceptible to leaf and stem rust. It is resistant to the races of bunt prevalent in Alaska, and is not as susceptible to loose smut as the parent variety Khogot.

Gasser is a feed wheat. It has high test weight and runs high in protein when grown in Alaska. It does not make good bread.

History.—Gasser (C.I. 13289; reg. 401) was selected from the cross Diamond × Khogot, made at the Fairbanks, Alaska Station in 1940. Diamond is an early Swedish variety and Khogot is an introduction from Siberia. Exact disposition of the progeny between 1940 and 1948 is unknown. In 1948 what is believed to have been the F_4 generation of the bulk hybrid was grown at the Matanuska, Alaska, station. The following year several hundred head selections were made from the bulked mate-

FIGURE 40.—*A*, Seneca and *B*, Anderson common wheats: spikes and glumes, × 1; kernels, × 3.

rial. Seed of Gasser traces back to bulked selections from a head row nursery grown at the Matanuska station in 1953.

Gasser was released by the Alaska Agricultural Experiment Station in 1955 (*115*).

ANDERSON

Description.—Plant intermediate habit, midseason, tall; stem white, midstrong; spike awnleted, oblong, lax, nodding; glumes glabrous, brown, long, midwide; shoulders narrow, rounded; beaks midwide, obtuse, 0.5 mm. long; awnlets white (light brown), 2 to 30 mm. long; kernels red, long, soft, elliptical; germ midsized; crease midwide, middeep; cheeks angular; brush midsized, midlong. (See fig. 40, *B*.)

Anderson is susceptible to stem rust and moderately resistant to leaf rust, powdery mildew, and loose smut. It is susceptible to soilborne mosaic and hessian fly. Anderson has sufficient winter hardiness to be grown in the area south of a line drawn from northern Louisiana to Maryland.

Anderson averages lower in protein content than the Atlas varieties, but is somewhat higher than Chancellor. Quality of Anderson is satisfactory for medium strength soft wheat flour.

History.—Anderson (C.I. 12536; reg. 369) was selected from the cross Leapland × Fronteira which was made at Arlington Farm, Rosslyn, Va., by the Crops Research Division. The line Y2652, later named Anderson, was selected at Beltsville, Md. It was entered in the Uniform Southern Soft Wheat Nursery in 1947. The selection was purified and increased by the Coker Pedigreed Seed Company, Hartsville, S.C., and by the South Carolina Agricultural Experiment Station. Anderson was released by the South Carolina Agricultural Experiment Station in 1951 (*10, 56*).

Distribution.—Anderson was grown on an estimated 375,894 acres in 1959, mostly in North Carolina and South Carolina. Smaller acreages were grown in Virginia, Alabama, Georgia, Mississippi. Tennessee, Ohio, Arkansas, and Maryland (*91*).

GAINES

Description.—Plant winter habit, midseason, short (semidwarf); stem white, strong; spike awned, oblong, middense to dense, inclined; glumes glabrous, white, long, midwide; shoulders narrow, oblique to rounded; beaks midwide, acuminate, 2 to 4 mm. long; awns white, 2 to 8 cm. long; kernels white, midlong, soft, ovate; germ small; crease midwide, shallow; cheeks rounded; brush midsized, midlong. (See fig. 41, *A*.)

Gaines is susceptible to stem rust, has slightly more resistance to leaf rust than Omar and Brevor, and is moderately resistant to stripe rust. It is resistant to races of bunt that were prevalent in the Pacific Northwest at the time of release, and moderately resistant to dwarf bunt.

Gaines is moderate in winter hardiness, being very similar to Omar and Brevor.

Gaines is the first semidwarf wheat to be released in the United States. It has strong straw and its yield record is superior to that of other Pacific Northwest commercial varieties. It is adapted to growing in the same areas as Omar and Brevor.

Gaines has better milling characteristics than Brevor, but does not measure up to Omar. It has satisfactory soft wheat baking quality.

History.—Gaines (C.I. 13448) was developed cooperatively by the Washington Agricultural Experiment Station and the Crops Research Division. The original cross of Norin 10 (a Japanese semidwarf wheat) and Brevor was made in 1949, in the greenhouse at Pullman, Wash. One of the selections was subsequently crossed with Orfed × a sister selection of Brevor, and in turn, a selection from this cross was crossed with Burt in 1952. Gaines is selection No. 9, which was made in 1956. It was grown in the yield nursery at Pullman, Wash., in 1958 and was entered in the Western Uniform White Wheat Nursery in 1960. Gaines was released to certified seed growers in the fall of 1961 by the Washington, Oregon, and Idaho Agricultural Experiment Stations.

ONAS 53

Description.—Plant spring habit, midseason, midtall; stem white, strong; spike awned, oblong, dense (lower ⅓ of spike middense), inclined; glumes glabrous, white, midlong, wide; shoulders wide to midwide, square to oblique; beaks midwide, acuminate, 3 to 10 mm. long; awns white, 2 to 7 cm. long; kernels white, short, soft, ovate; germ midsized; crease midwide, middeep to deep; cheeks rounded; brush midsized to large, midlong. (See fig. 41, *B*.)

Onas 53 is resistant to races of stem rust and bunt that were prevalent in California at the time of release. It is susceptible to leaf rust, is resistant to some races of powdery mildew, and has some degree of tolerance to yellow dwarf virus. It is susceptible to stripe rust.

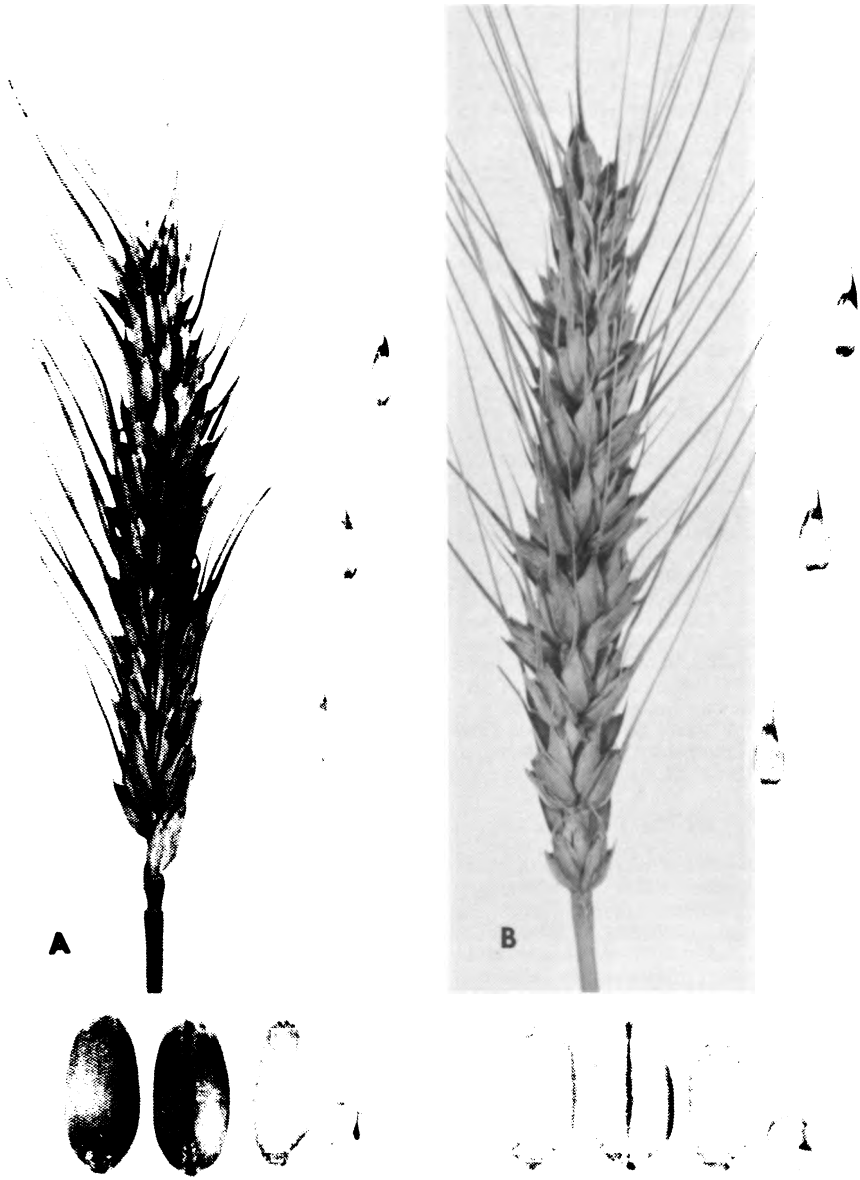

FIGURE 41.—*A*, Gaines and *B*, Onas 53 common wheats: spikes and glumes, × 1; kernels, × 3.

Onas 53 has awns and thus differs morphologically from Onas and Onas 41. It has a tendency to shatter under dry, windy harvest conditions (*84*).

When low in protein, Onas 53 produces good pastry flour. When it is higher in protein it can be used in blends to produce bread flour. In general, its milling properties are less satisfactory than its baking properties (*113*). Onas 53 has a slight advantage over Onas in test weight.

History.—Onas 53 (C.I. 13257; reg. 348) was developed cooperatively by the California Agricultural Experiment Station and the Crops Research Division.

It is the cumulative product of 3 backcrossing programs:

1. (Martin × White Federation[3]) × Onas[6] via a composite of 115 F_3 lines which resulted in Onas 41, C.I. 12229. It had the Martin resistance to bunt (*113*).

2. An Awned Onas (C.I. 12235) was composited from a bulk of 17 lines of Baart × Onas[9] and 7 lines of Baart × Onas[10], all of which were homozygous for the Baart type of awns (*112*).

3. By combining Awned Onas × Onas 41[2], Onas 49 was constituted. It and Onas 41 served as the recurrent parent in backcrosses to Kenya P.I. 117526. A simplified pedigree is (Kenya × Onas 41[5]) × Awned Onas[2]. A total of 250 F_3 selections were composited to form Onas 53.

Onas 53 was released by the California Agricultural Experiment Station in 1953.

Distribution.—Onas 53 was grown on an estimated 52,392 acres in 1959, mostly in California. Onas, Onas 41, Awned Onas, and Onas 53 acreages were combined in the 1959 Wheat Variety Survey. Most of the Onas grown in California in 1959 was believed to be either Awned Onas or Onas 53 (*91*). In this sense, awned Onas may be considered a synonym of Onas 53.

BURT

Description.—Plant winter habit, midseason, short; stem white, very strong; spike awned, oblong, dense, erect to inclined; glumes glabrous, white, midlong to long, midwide; shoulders midwide to narrow, oblique to square; beaks midwide to wide, acuminate, 2 to 4 mm. long; awns white, 1 to 6 cm. long; kernels white, midlong, hard, ovate; germ small; crease midwide, shallow; cheeks rounded; brush midsized, short to midlong.

Burt is susceptible to leaf and stem rust, and to loose smut. At the time of release in the Pacific Northwest it was resistant to the prevailing races of common bunt and dwarf bunt. Since that time, however, a race of dwarf bunt that is virulent on Burt and all other commercial varieties has become established in Montana.

Burt compares with Brevor, Omar, and Elmar in winter hardiness. None is as hardy as the Turkey type hard red winter wheats. Burt has a tendency to shatter on highly fertile land but less than most Turkey type wheats.

When the protein content is 12 percent or more, the flour from Burt is generally suitable for bread baking. At low protein levels it is semihard and compares with "yellow-berry" (low protein) hard red winter wheat, and must be blended with higher protein wheat to make satisfactory bread flour. In milling tests Burt has been more satisfactory than Rio.

History.—Burt (C.I. 12696; reg. 375) was developed from a cross made in 1944 between 27–15 and Rio × Rex. The selection 27–15 has the same pedigree as Brevor. Selection 41, later named Burt, was one of several F_4 lines grown in 1948. It was entered in the Western Uniform Winter Wheat Performance Nursery in 1952, and released jointly by the Washington and Oregon Agricultural Experiment Stations in the fall of 1956. Burt was developed cooperatively by the Washington Agricultural Experiment Station and the Crops Research Division.

Burt was named in honor of the late Dr. Burton B. Bayles, wheat breeder and agronomist with the Crops Research Division (*85*).

Distribution.—Burt was grown on an estimated 317,421 acres in 1959, about ⅔ of this acreage was in Washington and ⅓ in Oregon. Minor acreages were reported in Idaho and Utah (*91*).

BAART 46

Description.—Plant spring habit, early to midseason, midtall to tall; stem white, weak; spike awned, fusiform, middense, inclined; glumes glabrous, white, long, midwide; shoulders narrow, oblique to square; beaks midwide, acuminate, 3 to 5 mm. long; awns white, 3 to 6 cm. long; kernels white, long, semihard, ovate; germ small; crease narrow, shallow; cheeks rounded; brush midsized, short to midlong. (See fig. 42, *A*.)

Baart 46 can be readily identified by the large, yellowish pear-shaped kernels. It is very similar in all morphologic characters to Baart and Baart 38.

Baart 46 is resistant to some races of bunt and moderately resistant to some races of stem rust. As a result of rigid selection, it is more resistant than Baart 38 to stem rust. It is susceptible to yellow dwarf virus (*84*) and to stripe rust.

Baart 46 has a tendency to shatter under dry, windy harvest conditions.

Baart 46 is generally used for pastry flour, particularly when the protein content is low.

History.—Baart 46 (C.I. 12386) was developed cooperatively by the California Agricultural Experiment Station and the Crops Research Division. Thirteen of

FIGURE 42.—*A*, Baart 46 and *B*, Wichita common wheats: spikes and glumes, × 1; kernels, × 3.

the original 182 lines composited to make Baart 38 were backcrossed twice to Baart and the progenies selected for rust resistance from F_2 to F_5 segregates. Forty-five F_5 lines were composited in 1946 and increased. Baart 46 was released by the California Agricultural Experiment Station in the fall of 1948 (*10*).

Distribution.—Baart 46 was grown on an estimated 159,654 acres in 1959, in Washington, Idaho, California, Utah, Oregon, and on a small acreage in Arizona. Baart, Baart 38, and Baart 46 acreages were combined in the 1959 Wheat Variety Survey. It is assumed that Baart 46 has largely replaced Baart and Baart 38 (*91*).

WICHITA

Description.—Plant winter habit, very early, short; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white with black stripes, midlong, narrow to midwide; shoulders narrow, square to oblique; beaks narrow, acuminate, 3 to 12 mm. long; awns white and black, 3 to 8 cm. long; kernels red, short to midlong, hard to semihard, ovate with truncate tips; germ small; crease narrow, shallow; cheeks rounded; brush midsized, short. (See fig. 42 *B*.)

Wichita is susceptible to stem rust and leaf rust, but often escapes damage because of early maturity. It is susceptible to soilborne and streak mosaic, bunt, loose smut, and hessian fly.

Wichita is intermediate in winter hardiness. It is well adapted to central and western Kansas, eastern Colorado, and wheat growing areas to the south. It has a tendency to shatter under dry harvest conditions.

Wichita is considered a mellow gluten variety. It has a shorter mixing time and a lower mixing tolerance than such varieties as Bison or Comanche.

History.—Wichita (C.I. 11952; reg. 337) is a selection from a cross between Early Blackhull and Tenmarq made in 1929 at the Kansas Agricultural Experiment Station. The final selection was made in 1935 and was designated as Kansas 2739. Seed was increased in Kansas and Texas, and Wichita was jointly released by those experiment stations in 1944, in cooperation with the Crops Research Division (*10*, *92*),

Distribution.—Wichita was second only to Triumph in acreage in 1959. It was grown on 6,214,287 acres, principally in Kansas, Colorado, Oklahoma, and Texas. Smaller acreages were grown in New Mexico and Nebraska (*91*).

OMAHA

Description.—Plant winter habit, early, short; stem white, midstrong; spike awned, fusiform, middense, erect; glumes glabrous, white, midlong, narrow to midwide; shoulders narrow, oblique to square; beaks narrow, acuminate, 2 to 5 mm. long; awns white, 2 to 7 cm. long; kernels red, short to midlong, hard, ovate; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized, midlong. (See fig. 43, *A*.)

Omaha is susceptible to stem rust and leaf rust, moderately resistant to loose smut, resistant to bunt and soilborne mosaic, and susceptible to streak mosaic. It can be described as moderately susceptible to the western strain of hessian fly.

Omaha is sufficiently winter hardy for most areas of eastern Nebraska.

Omaha, a mellow gluten variety, has milling and baking characteristics similar to those of Pawnee. In Nebraska it has been consistently superior in test weight to Pawnee, Ponca, and Nebred, over a range from 0.5 to 1.5 pounds per bushel (*64*).

History.—Omaha (C.I. 13015) was developed cooperatively by the Nebraska Agricultural Experiment Station and the Crops Research Division. It is a selection from the cross Pawnee × Nebred, which was made at the Kansas Agricultural Experiment Station in 1942. An F_3 bulk lot of seed was obtained by the Nebraska Agricultural Experiment Station and propagated without selection at Alliance, Nebr., from 1945 through 1948. A head selection from the F_6 generation, made in 1948, was the progenitor of Omaha. It was grown 4 years in observation rows at Alliance, and then advanced to preliminary yield trials under the designation 502845. Omaha was included in the Nebraska Intrastate Nursery, field plots, and outstate tests in 1954 and in both the Uniform Southern and the Uniform Northern Regional Performance Nurseries in 1955. Omaha was released by the Nebraska Agricultural Experiment Station in 1960 (*64*).

PAWNEE

Description.—Plant winter habit, early, short; stem white, strong; spike awned, fusiform, middense, erect; glumes glabrous, white, midlong, midwide; shoulders narrow to wanting, oblique; beaks narrow, acuminate, 3 to 5 mm. long; awns white, 3 to 8 cm. long; kernels red, short, hard, ovate; germ midsized to large; crease midwide,

FIGURE 43.—*A*, Omaha and *B*, Pawnee common wheats: spikes and glumes, × 1; kernels, × 3.

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middeep; cheeks rounded; brush small, midlong. (See fig. 43, *B*).

Pawnee is moderately resistant to some races of stem rust (but susceptible to 56 and 15B), leaf rust, bunt, and hessian fly. It is resistant to loose smut and susceptible to soilborne and streak mosaic.

Pawnee is sufficiently winter hardy to be grown as far north as Nebraska, Iowa, and Illinois. It tends to shatter under dry harvest conditions.

Pawnee, a mellow gluten variety with a short mixing time, has good test weight.

History.—Pawnee (C.I. 11669; reg. 330) was developed cooperatively by the Kansas and Nebraska Agricultural Experiment Stations and the Crops Research Division. It is a selection from the cross Kawvale × Tenmarq made at Manhattan, Kans., in 1928. Seed of F_3 plants was sent to Lincoln, Nebr., in the fall of 1931. The F_3 designated as 4444–3 was early, resistant to hessian fly, and high in yield in a single rod row. It was entered in the Uniform Hard Red Winter Wheat Performance Nursery in 1935 and in field plots at Lincoln, Nebr., and Manhattan, Kans., in 1936. The selection was named Pawnee in 1941 and released by the Nebraska Agricultural Experiment Station in 1942, and by the Kansas Agricultural Experiment Station in 1943 (*10, 92*).

Distribution.—Pawnee was grown on an estimated 3,981,515 acres in 1959. Pawnee was reported grown in more States in 1959 than any other variety. Kansas and Nebraska each reported over 1 million acres; Illinois and Missouri more than 500,000 acres; Iowa more than 100,000 acres; Oklahoma, Indiana, and Colorado more than 10,000 acres; Virginia, Tennessee, Wisconsin, Texas, Michigan, Kentucky, Pennsylvania, Arkansas, and Ohio each more than 1,000 acres; and North Carolina more than 500 acres (*91*).

PONCA

Description.—Ponca resembles Pawnee in observable characters. The shoulders (of the glumes) are somewhat wider and often square near the top of the spike, and the beaks slightly longer. Ponca is similar to Pawnee in time of maturity, plant height, slightly weaker in strength of straw, higher in test weight, and slightly less resistant to loose smut. It is susceptible to bunt, soilborne mosaic, and to stem rust. It is superior in resistance to leaf rust, hessian fly resistance, and to shattering, but is not as winter hardy as Pawnee. It has seedling as well as adult plant resistance to leaf rust. The grain does not sprout in the head nor bleach as readily as in Pawnee.

Mixing time of Ponca is medium-long and mixing tolerance good. Overall quality characteristics are good.

History.—Ponca (C.I. 12128; reg. 372) was selected from the cross of Kawvale–Tenmarq with an F_3 plant of Kawvale–Marquillo made in 1935. The maternal parent is a sister selection of Pawnee. The F_1 was grown at Manhattan, Kans., in 1936 and the selection that became Ponca was made in 1941 from the F_6 generation. It was assigned the number Kansas 41841. It was tested in Kansas from 1942 to 1944 and entered in the Regional Testing Program in the Southern Plains in 1945. Ponca was released in 1951 by the Kansas and Oklahoma Agricultural Experiment Stations in cooperation with the Crops Research Division for distribution in the eastern part of the two States (*56, 73*).

Distribution.—Ponca was grown on an estimated 1,666,719 acres in 1959, mostly in Kansas. Ponca, like Pawnee, was grown in a number of States but many had small acreages. Kansas reported more than 1 million acres; Missouri more than 100,000 acres; Nebraska, Illinois, and Oklahoma more than 25,000 acres; Texas more than 20,000 acres; Colorado, Iowa, Indiana, Arkansas, New Mexico, and Michigan more than 1,000 acres each; and Georgia and Pennsylvania more than 500 acres (*91*).

KAW

Description.—Plant winter habit, early, midtall to short; stem white, midstrong to weak; spike awned, fusiform, middense, inclined; glumes glabrous, white, midlong, narrow to midwide; shoulders midwide, oblique to rounded; beaks midwide, acuminate, 2 to 4 mm. long; awns white, 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized, short. (See fig. 44, *A*.)

Kaw (Kansas source of seed) is resistant to race 56 of stem rust, but not to race 15B. It is resistant to the races of leaf rust that were prevalent in Kansas at the time of release. Kaw is resistant to bunt, susceptible to loose smut, soilborne mosaic, streak mosaic, and hessian fly.

Kaw is not quite as winter hardy as Wichita, and shatters less than Wichita (*5*).

FIGURE 44.—*A*, Kaw and *B*. Bison common wheats: spikes and glumes, × 1; kernels, × 3.

Kaw is high in test weight and is a good quality hard wheat. Mixing time approaches that of Cheyenne.

History.—Kaw (C.I. 12871) was selected from the cross (Early Blackhull × Tenmarq) × (Oro × Mediterranean-Hope), which was made in 1941. The maternal parent was a sister selection of Wichita. The final selection, in the F_6 generation, was made in 1947 and given the number Ks 471238. It was entered in the Uniform Hard Red Winter Wheat Performance Nursery in 1953. Kaw was released jointly by the Kansas and Oklahoma Agricultural Experiment Stations in 1960 in cooperation with the Crops Research Division. The original material segregated for resistance to stem rust race 56. Later breeders' seed was purified so that Kaw (Kansas source) was homozygous for resistance.

CROCKETT

Description.—Plant winter habit, early, midtall; stem white, weak to midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white with black stripes, midlong, midwide; shoulders narrow to wanting, oblique; beaks midwide, acuminate, 5 to 15 mm. long; awns white and black, 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, short.

Crockett is highly resistant in the adult plant stage to races of leaf rust which were common in Texas at the time of release. It is resistant to stem rust race 56 but susceptible to 15B. It is moderately resistant to loose smut and bunt, resistant to soilborne mosaic, and susceptible to streak mosaic and to stripe rust.

Crockett is intermediate to Comanche and Wichita in maturity. It is sufficiently winter hardy for growing in north-central and northwestern Texas (*56*).

Crockett, high in test weight, is a mellow gluten hard red winter wheat with mixing properties that are somewhat superior to Wichita.

History.—Crockett (C.I. 12702; reg. 363) resulted from efforts over a period of 15 years to combine disease resistance and good quality with early maturity. Sinvalocho was crossed with Wichita and the F_1 was then crossed to Hope–Cheyenne. A leaf rust resistant F_2 segregate was again crossed to Wichita in 1940 and the final selection resulting in Crockett was made in 1947. It was tested as Texas 237–46–22 and entered in the Regional Performance Nursery in 1950. Crockett was developed cooperatively by the Texas Agricultural Experiment Station and the Crops Research Division. It was released in the fall of 1956 (*2, 56*).

Distribution.—Crockett was grown on an estimated 359,957 acres in 1959 in Texas and Oklahoma (*91*).

BISON

Description.—Plant winter habit, early to midseason, short to midtall; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white and white with black stripes, short, narrow to midwide; shoulders midwide, square to rounded; beaks narrow to midwide, acuminate, 2 to 4 mm. long; awns white and black, 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, short to midlong. (See fig. 44, *B*.)

Bison is susceptible to stem rust, leaf rust, loose smut, and soilborne mosaic. It is resistant to bunt and has tolerance to streak mosaic. It is susceptible to hessian fly.

Bison has sufficient winter hardiness for Kansas and southern Nebraska growing conditions.

Bison has good hard wheat milling and baking properties. It is very similar agronomically to Kiowa but has superior quality characteristics. It has a medium-long mixing time and good mixing tolerance. Its water-absorption requirement is equal to that of Comanche and Ponca (*58*).

History.—Bison (C.I. 12518; reg. 371) was selected from the cross Chiefkan × Oro–Tenmarq, which was made at the Kansas Agricultural Experiment Station in 1938. The Oro–Tenmarq parent is a sister selection of Comanche. The first generation was grown at Manhattan, Kans., in 1939 and later generations were grown at Hays, Kans., where the final selection was made in 1943 from the F_5 generation. It was designated as HC 46–41 and tested extensively in Kansas from 1948 to the time of release. It was entered in the Uniform Hard Red Winter Wheat Central and Southern Performance Nurseries in 1949. Bison was released in 1956 by the Kansas Agricultural Experiment Station in cooperation with the Crops Research Division (*56, 58*).

Distribution.—Bison was grown on an estimated 1,364,462 acres in 1959, mostly in Kansas. Nebraska and Colorado had smaller acreages (*91*).

NEBRED

Description.—Plant winter habit, midseason, short to midtall; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders narrow to wanting, oblique; beaks narrow to midwide, acuminate, 2 to 8 mm. long; awns white, 3 to 8 cm. long; kernels red, midlong, hard, ovate to elliptical; germ small; crease narrow to midwide, middeep; cheeks rounded; brush small, midlong.

Nebred is susceptible to stem rust, leaf rust, soilborne mosaic, loose smut, streak mosaic, and hessian fly. It is resistant to the races of bunt prevalent in Nebraska.

Nebred is a winter-hardy variety adapted to Nebraska and South Dakota.

Nebred is a good quality bread wheat with a medium-long mixing time. Flour made from Nebred has an intense yellow color not found in most other varieties.

History.—Nebred (C.I. 10094; reg. 321) was developed cooperatively by the Nebraska Agricultural Experiment Station and the Crops Research Division. It is a selection from a plot of Turkey (S. Dak. 144, C.I. 3684) grown at Lincoln, Nebr., in 1924. Seed for the plot had been inoculated with bunt. Heads were selected from plants that were free of bunt and that showed the lowest degree of stem-rust infection. In succeeding years these selections were inoculated with bunt, and only the resistant ones continued. The selected lines were bulked and entered in the Uniform Hard Red Winter Wheat Performance Nursery in 1932, and designated as Nebraska 1063. Nebred was released by the Nebraska Agricultural Experiment Station in 1938 (*10, 92*).

Distribution.—Nebred was grown on an estimated 1,411,882 acres in 1959, mostly in Nebraska and South Dakota. Smaller acreages were grown in Colorado, Kansas, and Wyoming (*91*).

WARRIOR

Description.—Plant winter habit, midseason, short; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white, short to midlong, midwide; shoulders midwide, square to oblique; beaks midwide to narrow, acuminate, 1 to 3 mm. long; awns white, 2 to 8 cm. long; kernels red, short, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong. (See fig. 45, *A*.)

Warrior is susceptible to stem rust and leaf rust. It is resistant to loose smut and susceptible to bunt, soilborne mosaic, and streak mosaic. It has moderate resistance to the western strain of hessian fly.

Warrior is adapted particularly to western Nebraska. It possesses winter hardiness similar to that of Nebred and slightly superior to that of Cheyenne.

Warrior produces grain with only fair test weight but has good hard wheat milling and baking properties. Mixing time is medium-long.

History.—Warrior (C.I. 13190) was developed cooperatively by the Nebraska Agricultural Experiment Station and the Crops Research Division. It is a selection from the cross Pawnee × Cheyenne, which was made in 1942. The F_2 to F_5 generations were propagated as an unselected bulk at Lincoln, Nebr. Head selections made in 1947 were grown in head rows at Lincoln in 1948 and in single 10-foot rows at Alliance, Nebr., in 1949 and 1950. Neb. 483310, which was later named Warrior, was entered in yield trials at North Platte in 1953 and in statewide tests in 1954. It was included in the Uniform Northern Regional Performance Nursery in 1957. Warrior was released by the Nebraska Agricultural Experiment Station in 1960 (*65*).

AZTEC

Description.—Plant winter habit, midseason, midtall; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white with black markings, short, narrow; shoulders midwide, rounded to square; beaks narrow to midwide, acute to acuminate, 1 to 4 mm. long; awns white and black, 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong to short.

Aztec is resistant to stripe rust, and susceptible to stem rust and leaf rust. It is susceptible to loose smut, bunt, and soilborne mosaic. Aztec has some degree of tolerance to streak mosaic.

Aztec is nonshattering but is easier to thresh than RedChief. It is a winter-hardy variety, comparable to Cheyenne and Nebred, and is adapted to semiarid growing conditions.

Aztec is a good-quality hard wheat with high test weight. It has a medium-long mixing time, similar to Nebred.

History.—Aztec (C.I. 13016; reg. 405) was selected from the cross RedChief × Cheyenne, made at the Nebraska Agricultural Experiment Station in 1942.

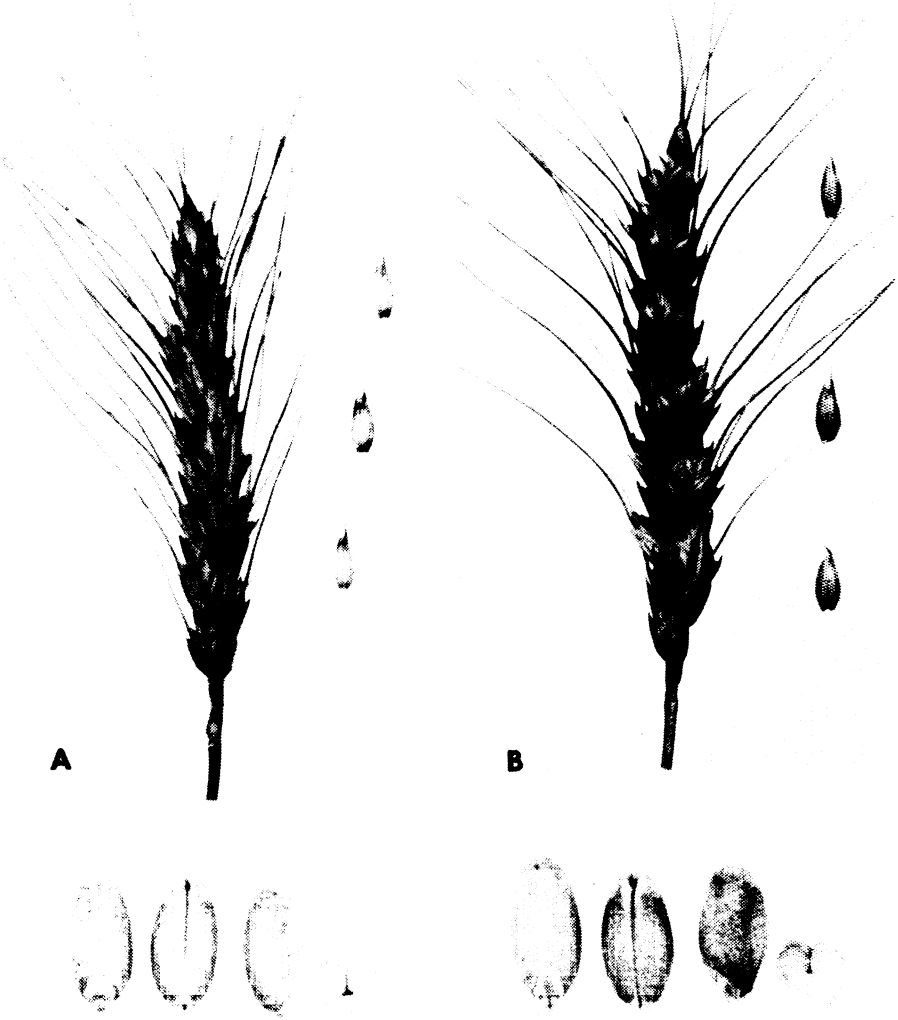

FIGURE 45.—*A*, Warrior and *B*, Triumph common wheats: spikes and glumes, × 1; kernels, × 3.

It was maintained as a bulk hybrid until 1947. The line destined to become Aztec was selected in 1948, and assigned the number NP 482809. It was obtained for testing in New Mexico in 1952, and was entered in the Uniform Hard Red Winter Wheat Southern and Central Performance Nurseries in 1957. Aztec was released by the New Mexico Agricultural Experiment Station in cooperation with the Crops Research Division in 1958 (*3*).

Distribution.—Aztec was grown on an estimated 693 acres in 1959, all in New Mexico (*91*).

TRIUMPH

Description.—Plant winter habit, very early, short; stem white, strong; spike awned, fusiform to oblong, middense, erect; glumes glabrous, white, midlong, narrow to midwide; shoulders narrow to wanting; beaks midwide, acuminate, 2 to 5 mm. long; awns white, 3 to 8 cm. long; kernels red, short to midlong, hard, ovate; germ small; crease midwide, shallow; cheeks rounded; brush midsized, midlong. (See fig. 45, *B*.)

Triumph is susceptible to leaf and stem rust, soilborne mosaic, and bunt. It is moderately resistant to loose smut and tolerant to streak mosaic. Because of its earliness, Triumph generally escapes heavy rust damage. It is susceptible to hessian fly.

Triumph is not as winter hardy as Pawnee.

Triumph has good milling characteristics but is only fair in quality for bread baking. It is considered a mellow gluten type, similar to Wichita and Pawnee.

History.—Triumph (C.I. 12132; reg. 368) was developed by a private plant breeder, Mr. Joseph Danne, El Reno, Okla. Mr. Danne crossed Blackhull with Kanred in 1924. The next year he crossed Florence, known also as Burbank Quality, with the Blackhull-Kanred hybrid. In 1926 he crossed Blackhull-Kanred with Blackhull-Kanred × Florence. One of the plants from this cross was very short and the first of the progenies to ripen. It was assigned the number C7H. The selection that became Triumph traces back to this short, early plant grown in 1927. Triumph was distributed by Mr. Danne in 1940.

Several other strains of wheat closely resembling Triumph were developed by Mr. Danne in the course of his breeding work. These include Improved Triumph, Rust Resistant Triumph, Newest Improved Triumph, and Super Triumph. The latter is discussed as a separate variety. These strains have many characters in common, having been bred with a similar objective. While their pedigrees differ, as given by Mr. Danne, they have many of the same ancestors. It is not yet clear which ones, if any, other than Super Triumph, should be set apart as being distinctly different varieties.

Improved Triumph (C.I. 13667) is similar to Triumph in reaction to diseases and in morphologic characters. It has slightly weaker and shorter straw, wider shoulders, shorter beaks, and a slightly larger germ than Triumph but none of these differences is great. The spikes are somewhat inclined and it is about one day earlier in maturity. Improved Triumph appears to be about equal to Triumph in milling and baking quality. Mr. Danne crossed Danne Beardless × Blackhull with Kanred-Blackhull × Forence in 1927. Mr. Danne's original notes indicate that Danne Beardless may be Fultz or a selection from Fultz. The selection which became Improved Triumph was made in 1935. The variety was tested in Mr. Danne's nurseries until about 1942 and then released to Oklahoma growers for general planting. It was grown on a limited acreage in Oklahoma in 1959 and possibly some in Texas and Kansas.

Rust Resistant Triumph (C.I. 13679) is very similar to Triumph in reaction to diseases and in morphologic and agronomic characters. It is practically impossible to distinguish this selection from Triumph under field conditions. It appears to have wider shoulders, a slightly larger germ, and shorter, more blocky kernels than Triumph; however, these differences are rather minute. Milling and baking properties appear to be the same as those of Triumph. According to Mr. Danne's records, the cross [Danne Beardless-Blackhull × (Kanred-Blackhull × Florence)] × (Kanred-Blackhull × Triumph) was made in 1934 and Rust Resistant Triumph, selected from this cross, was released by him about 1948 or 1949. Rust Resistant Triumph has been grown on a limited acreage in Oklahoma and possibly some in Texas and Kansas.

Rosetta (C.I. 13363) is similar to Triumph in agronomic, disease resistance, and morphologic characters. The heads tend to incline more at full maturity and the awns may be slightly shorter. No conclusive data on milling and baking are available. Rosetta is believed to be a selection from Triumph. It was increased and distributed by an Oklahoma farmer. Rosetta was grown on an estimated 23,987 acres in 1959 in Oklahoma and Texas (*91*). The name is considered a synonym of Triumph.

Newest Improved Triumph (C.I. 13668) is similar to Triumph in reaction to diseases and in morphologic characters. It has somewhat weaker straw than Triumph, wider shoulders, shorter beaks, longer kernels, a larger germ, and a somewhat more inclined spike, but none of these differences is great. Milling and baking properties appear to be the same as those of Triumph. Newest Improved Triumph was selected from the cross [(Danne Beardless-Blackhull) × (Kanred-Blackhull × Florence) × Triumph]^2 × Florence with (Kanred-Blackhull selection × Triumph) × [(Danne Beardless-Blackhull) × (Kanred-Blackhull × Florence)]. The last cross was made in 1939, the last selection was made in 1950, and seed was released by Mr. Danne in 1954. Only a limited acreage was reported in 1959.

Distribution.—Triumph, with 6,341,167 acres, was the leading wheat variety in the United States in 1959. Most of the acreage was in Oklahoma, Texas, and Kansas but some Triumph was grown in Colorado, Nebraska, Missouri, Arkansas, Illinois, Kentucky, and Tennessee (*91*). The acreage of Rosetta was 23,987 and that of the other selections very small, mostly in Oklahoma (*91*).

Synonyms.—Early Triumph, Premium, Early Premium, Danne's Triumph, Rosetta. In parts of Kentucky and Tennessee where Triumph has recently been grown, it is referred to as "Oklahoma" wheat. The variety status of Rust Resistant Triumph, Improved Triumph, and of Newest Improved Triumph remains uncertain.

SUPER TRIUMPH

Description.—Plant winter habit, very early (2 to 3 days earlier than Triumph), short to midtall; stem white, midstrong to weak; spike awned, fusiform to oblong, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide to narrow, elevated to square; beaks midwide, acuminate, 5 to 15 mm. long; awns white, 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized, short.

Super Triumph is susceptible to leaf and stem rust, but because of its earliness it generally escapes heavy rust damage. Its reaction to other diseases and insects has not been determined.

Milling and baking properties appear to be the same as those of Triumph.

History.—Super Triumph (C.I. 13669) was developed by a private plant breeder, Mr. Joseph Danne, El Reno, Okla. In 1927 he crossed a hybrid of Danne Beardless × Blackhull with another hybrid from a Kanred-Blackhull × Florence (Burbank Quality) cross. A selection from this cross was then crossed with a hybrid of Kanred-Blackhull × Triumph in 1934. The pedigree is as follows: [Danne Beardless-Blackhull × (Kanred-Blackhull × Florence)] × (Kanred-Blackhull × Triumph). Selections were made for at least four generations before the line that became Super Triumph was chosen. This variety was released about 1957.

Distribution.—Super Triumph was grown on limited acreages in 1959, primarily in Oklahoma with small acreages in both northern Texas and southern Kansas.

KIOWA

Description.—Plant winter habit, early, midtall; stem white, midstrong; spike awned, fusiform to oblong, middense, inclined; glumes glabrous, white with black markings, midlong, midwide; shoulders narrow to wanting, oblique; beaks narrow, acuminate, 2 to 3 mm. long; awns white and black, 3 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, middeep; cheeks angular; brush midsized, midlong.

Kiowa has considerable tolerance to streak mosaic but is susceptible to stem rust, leaf rust, loose smut, soilborne mosaic, and hessian fly. It is resistant to the races of bunt common in Kansas.

Kiowa is intermediate in winter hardiness and well adapted to the western half of Kansas.

Kiowa is very similar to Bison in agronomic characteristics but is not as good in bread-baking quality. It can be described as a mellow gluten variety with a medium-short mixing time. Test weight of Kiowa is generally about 1 pound heavier than Comanche (*10*).

History.—Kiowa (C.I. 12133; reg. 346) was selected from the cross Chiefkan × Oro-Tenmarq. The latter parent is a sister selection of Comanche. The cross was made at the Kansas Agricultural Experiment Station, Manhattan, Kans., in 1938. Selection and early testing was conducted at the Fort Hays Branch Experiment Station. It was entered in the Uniform Hard Red Winter Wheat Performance Nursery as Hays Cereal No. 43–112 in 1945. Kiowa was released in 1950 by the Kansas Agricultural Experiment Station in cooperation with the Crops Research Division (*10, 92*).

Distribution.—Kiowa was grown on an estimated 1,645,114 acres in 1959, nearly all in Kansas. Smaller acreages

were grown in Okahoma, Texas, Colorado, and Nebraska (*91*).

COMANCHE

Description.—Plant winter habit, early to midseason, short to midtall; stem white, midstrong; spike awned, oblong, middense, inclined; glumes glabrous, white, short to midlong, midwide; shoulders narrow, oblique to square (few elevated); beaks narrow, acuminate, 5 to 15 mm. long; awns white, 3 to 8 cm. long; kernels red, short to midlong, hard, ovate; germ midsized; crease midwide, middeep to deep; cheeks angular; brush midsized, midlong. (See fig. 46, *A*.)

Comanche is resistant to some races of stem rust and leaf rust, but not to stem rust race 15B. It is resistant to many races of bunt and to soilborne mosaic, but susceptible to loose smut, streak mosaic, and hessian fly.

Comanche possesses only moderate winter hardiness so is generally not grown north of Kansas and Colorado.

Comanche is a good quality milling and baking hard wheat. Its mixing time is medium to medium-long. It has strong dough properties and can be used in blends to strengthen weaker gluten wheats.

History.—Comanche (C.I. 11673; reg. 331) was selected from the cross Oro × Tenmarq, which was made in 1928 at the Kansas Agricultural Experiment Station. The selection that resulted in Comanche was made in the F_5 generation and designated as Kansas 2729. It was included in the Uniform Hard Red Winter Wheat Performance Nursery in 1937. Comanche was released jointly in 1942 by the Kansas, Oklahoma, and Texas Agricultural Experiment Stations in cooperation with the Crops Research Division (*10*, *92*).

Distribution.—Comanche was grown on an estimated 1,880,303 acres in 1959, about one-half in Kansas. Other States growing Comanche were Texas, Colorado, Oklahoma, and New Mexico (*91*).

DELMAR

Description.—Plant winter habit, midseason, midtall; stem white, strong; spike awned, oblong (sometimes slightly clavate), middense, erect; glumes glabrous, white, midlong, midwide; shoulders midwide, rounded; beaks narrow, acuminate, 3 to 5 mm. long; awns white, 2 to 10 cm. long; kernels red, midlong, hard, ovate to elliptical; germ midsized; crease midwide, middeep to shallow; cheeks rounded; brush midsized to small, midlong.

Delmar is resistant to most races of bunt and dwarf bunt common to the Intermountain area. It is resistant to stripe rust.

Limited tests indicate that Delmar is a good quality hard wheat. It has a long mixing time and produces a good loaf of bread. It has greater mixing tolerance and better baking qualities than Cache and Wasatch, other dryland varieties grown in Utah.

History.—Delmar (C.I. 13442) resulted from a cross between Utah Kanred and Brevor, made in 1949 at the Utah Agricultural Experiment Station. Selection 208–63–2–1, which was named Delmar, represents an unusual segregate in that it possesses quality characteristics (strong mixing properties) not found in either parent. It was entered in the Uniform Western Hard Red Winter Wheat Performance Nursery in 1959. Delmar was released by the Utah Agricultural Experiment Station to certified seed growers in the fall of 1961 (*59*).

CHEYENNE

Description.—Plant winter habit, midseason, short to midtall; stem white, strong; spike awned, oblong to fusiform, middense, erect; glumes glabrous, white, midlong, midwide; shoulders midwide to wide, oblique to elevated; beaks midwide, acuminate, 2 to 5 mm. long; awns white, 3 to 8 cm. long; kernels red, midlong, hard, ovate to elliptical; germ small; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 46 *B*.)

Cheyenne is susceptible to most races of stem rust, leaf rust, bunt, loose smut, soilborne mosaic (*109*), streak mosaic, and hessian fly.

Cheyenne is more winter hardy than Turkey and is adapted to the northern part of the hard red winter wheat region.

Cheyenne has a longer mixing time than Turkey, and if handled properly, the flour will produce good bread. It is a strong gluten wheat that is desirable for blending with weaker gluten wheats.

History.—Cheyenne (C.I. 8885; reg. 269) is the increase from a single plant selected from Crimean. The selection was made at the Nebraska Agricultural Experiment Station in 1922. It was included in plot tests at Lincoln, Nebr., in 1927 and released in 1930 as Nebraska 50. The seed became mixed and a purified lot was released under the name Cheyenne in 1933 in cooperation with the Crops Research Division (*10*, *92*).

Distribution.—Cheyenne was grown on an estimated 2,560,522 acres in 1959. Nebraska and Montana had the largest

FIGURE 46.—*A*, Comanche and *B*, Cheyenne common wheats: spikes and glumes, × 1; kernels, × 3.

acreages, followed by Colorado, Wyoming, and Kansas. Oklahoma, South Dakota, New Mexico, Texas, and North Dakota had smaller acreages (*91*).

Synonym.—Nebraska No. 50.

TENDOY

Description.—Plant winter habit, midseason, midtall; stem white, midstrong; spike awned, oblong to fusiform; middense, erect; glumes glabrous, white, midlong, narrow to midwide; shoulders midwide, rounded to elevated; beaks narrow, acuminate, 2 to 4 mm. long; awns white, 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ small; crease midwide, middeep; cheeks rounded; brush midsized, midlong to short.

Tendoy is susceptible to stem rust and leaf rust. It is resistant to common bunt, having the M, R, and M_2 genes for bunt resistance, but is susceptible to dwarf bunt (*89*).

Tendoy is sufficiently winter hardy to be grown in the Intermountain areas of the Northwestern United States. It has a tendency to shatter in some locations.

Quality of Tendoy is very similar to Cheyenne. It has satisfactory milling characteristics, a long mixing time, and high water absorption. It is considered a good quality hard red winter wheat.

History.—Tendoy (C.I. 13426) was selected from the cross Rex-Rio × Cheyenne[4]. The original cross was made in 1946 at the California Agricultural Experiment Station, Davis, Calif., in cooperation with the Crops Research Division. Backcrosses to Cheyenne were made at the Idaho Agricultural Experiment Station, Moscow, Idaho, between 1948 and 1951. In 1957, eight similar F_6 bunt-free lines were bulked and entered in the 1958 Western Uniform Regional Hard Red Winter Wheat Nursery. Tendoy was released by the Idaho Agricultural Experiment Station in 1960 (*89*).

SHOSHONI

Description.—Shoshoni is difficult to distinguish from Cheyenne. Shoulders on the glumes of Shoshoni vary from predominantly square to elevated, while shoulders on Cheyenne glumes are more oblique to elevated.

Shoshoni is susceptible to stem rust, leaf rust, loose smut, bunt, and powdery mildew.

Shoshoni is similar to Cheyenne in winter hardiness.

Shoshoni is a good quality hard red winter wheat with a long mixing time.

History.—Shoshoni (C.I. 13193) was selected from Cheyenne in 1956. It was entered in the Northern Regional Performance Nursery in 1958 as W.S. 318. Shoshoni was released by the Wyoming Agricultural Experiment Station in the fall of 1961. Its area of adaptation is similar to that of Cheyenne.

LATHROP

Description.—Plant spring habit, midseason, midtall; stem purple, midstrong; spike awned, fusiform, lax, inclined; glumes glabrous, white, long, midwide; shoulders narrow, square to elevated; beaks narrow, acuminate, 3 to 5 mm. long; awns white, 5 to 8 cm. long; kernels red, midlong, semihard, ovate; germ small to midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 47, *A*.)

Lathrop is moderately resistant to leaf rust, resistant to some races of stem rust (but not to 15B), susceptible to loose smut and powdery mildew, and resistant to hessian fly.

Lathrop is used as a feed wheat, and is semihard in kernel texture. It has fair bread-baking characteristics, being lower than Selkirk in protein content, loaf volume, crumb properties, water absorption, flour ash, and flour yield but higher in test weight.

Lathrop is very similar to Henry in morphologic characters, disease reaction, and quality.

History.—Lathrop (C.I. 13457) was developed from an interspecific cross of Henry with a durum designated as P.I. 94587. Henry was the recurrent parent in a series of six backcrosses. F_4 rows (82 in number) were bulked after greenhouse testing for hessian fly resistance. The bulk population was tested in the field for 3 years under fly infestation conditions, and entered as Wis. 253 in the Uniform Hard Red Spring Performance Nursery in 1959. The fly resistance of Lathrop is derived from its durum parent, P.I. 94587. Lathrop was released to certified seed growers in the spring of 1961. It was developed cooperatively by the Wisconsin Agricultural Experiment Station and the Crops Research and Entomology Research Divisions (*108*).

MIDA

Description.—Plant spring habit, midseason, midtall; stem purple, midstrong; spike awned, fusiform, lax to middense, inclined; glumes glabrous, white, long, wide to midwide; shoulders narrow, elevated; beaks narrow, acuminate, 5 to 15 mm. long; awns white (and black), 5 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized to

FIGURE 47.—*A*, Lathrop and *B*, Centana common wheats: spikes and glumes, × 1; kernels, × 3.

large; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Mida is resistant to some races of leaf rust, and to some races of stem rust (but not 15B). It is resistant to bunt and susceptible to loose smut.

Mida has good milling and baking quality. It produces a loaf of bread with better crumb structure and crumb color than does Thatcher. It is higher in test weight and flour yield than Thatcher but has weaker gluten.

Mida has a tendency to shatter.

History.—Mida (C.I. 12008; reg. 338) was developed from a cross made in 1933 between Mercury and R.L. 625. Mercury originated from a cross involving Ceres and a selection from Hope × Florence. R.L. 625 was a Canadian selection from "Double Cross" × Ceres. "Double Cross" was the Marquis-Iumillo × Marquis-Kanred hybrid from which Thatcher was selected. An F_5 line, Ns 2829, was selected in 1936 and released in 1944 as Mida by the North Dakota Agricultural Experiment Station (*124*).

Distribution.—Mida was grown on an estimated 221,326 acres in 1959, mostly in North and South Dakota (*91*).

RUSSELL

Description.—Plant spring habit, midseason, midtall to tall; stem white, weak; spike awned, fusiform, middense to lax, inclined to nodding; glumes glabrous, extremely white, long, midwide; shoulders narrow, square to elevated; beaks midwide, acuminate, 4 to 6 mm. long; awns white, 2 to 8 cm. long; kernels red, short, hard, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Russell is susceptible to leaf rust, moderately resistant to some races of stem rust (including 15B), resistant to loose smut, moderately resistant to powdery mildew, moderately susceptible to bunt, and resistant to hessian fly. It has the H_3 factor for hessian fly resistance.

Russell is used as a feed wheat; it has only fair bread-baking quality. It generally is lower in protein content than good quality hard red spring varieties and has weaker gluten.

History.—Russell (C.I. 12484; reg. 382) was developed from a cross made in 1939 between Thatcher and W38 × Hope. It was grown as a bulk hybrid from the F_2 through the F_5 generations. Several F_5 plants were selected in 1943 and grown in plant rows in 1944. One of these rows, H195–45, was the forerunner of Russell. It was entered as Wis. 242 in the Hard Red Spring Wheat Performance Nursery in 1947. Russell was released to certified seed growers by the Wisconsin Agricultural Experiment Station in the spring of 1956. It was developed cooperatively by the Wisconsin Agricultural Experiment Station and the Crops Research and Entomology Research Divisions (*56*).

Distribution.—Russell was grown on an estimated 8,473 acres in 1959, mostly in Wisconsin (*91*).

CERES

Description.—Plant spring habit, midseason, midtall; stem white, midstrong; spike awned, fusiform, middense, erect to inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, rounded to elevated; beaks midwide to narrow, acuminate, 2 to 10 mm. long; awns white, 3 to 8 cm. long; kernels red, midlong, hard, ovate; germ small; crease midwide, shallow to middeep; cheeks rounded to angular; brush midsized, short.

Ceres is susceptible to leaf rust and resistant to some races of stem rust (but not to races 56 or 15B). It is susceptible to bunt and loose smut. It has some degree of tolerance to drouth.

Ceres produces grain of good milling and baking quality. It generally exceeds Thatcher in test weight and water absorption of the flour.

History.—Ceres (C.I. 6900; reg. 241) was developed from a cross made in 1918 between Marquis and Kota. It was the immediate increase of an F_2 plant. The parents differed widely in many characteristics—it is most unusual for a variety to be developed from an F_2 selection and increased from that generation. It was released in 1926 by the North Dakota Agricultural Experiment Station (*123*). Ceres was widely grown through 1935, but acreage rapidly declined after the 1935 epidemic of race 56 of stem rust (*10*).

Distribution.—Ceres was grown on an estimated 272,864 acres in 1959, mostly in Montana (*91*).

CENTANA

Description.—Plant spring habit, midseason to late, midtall; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, white, midlong, midwide; shoulders midwide, square to elevated; beaks narrow, acuminate, 4 to 8 mm. long; awns white, 2 to 8 cm. long; kernels red, short, hard, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong to short. (See fig. 47, *B*.)

Centana is susceptible to leaf and stem rust, moderately resistant to bunt, resistant to loose smut, and susceptible to wheat stem sawfly.

Ash content of Centana flour is low, water absorption high, and gluten is strong. Loaf volume is better than expected for the protein content.

History.—Centana (C.I. 12974; reg. 383) was developed cooperatively by the Montana Agricultural Experiment Station and the Crops Research Division from a cross of Pilot 13 with Thatcher, backcrossed to Pilot 13. The backcross was made in 1941. Progenies were grown at Bozeman, Mont., and Langdon, N. Dak. The selection that became Centana was assigned the designation N2170 in 1946. It was grown in the Montana Intrastate Nursery in 1948 and 1949, in the Montana Advanced Yield Nursery in 1952, and in the Uniform Spring Wheat Regional Performance Nursery in 1952. Centana was released by the Montana Agricultural Experiment Station in 1958 (*56, 79*).

Distribution.—Centana was grown on an estimated 311,107 acres in 1959, mostly in Montana. South Dakota, North Dakota, and Wyoming grew smaller acreages of Centana (*91*).

CONLEY

Description.—Plant spring habit, midseason to late, midtall; stem white, strong; spike awned, fusiform to oblong, middense, erect to inclined; glumes glabrous, white, long, midwide; shoulders midwide to narrow, elevated; beaks wide, acuminate, 6 to 12 mm. long; awns white, 2 to 7 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, middeep; cheeks rounded; brush midsized, midlong. (See fig. 48, *A*.)

Conley is moderately resistant to the races of leaf rust that were predominant at the time of release. It has resistance to prevailing stem rust races, including race 15B, at average temperatures. At high temperatures in seedling tests it is less susceptible to race 15B than is Selkirk. Conley is moderately resistant to loose smut and bunt. A serious weakness is susceptibility to brown necrosis, which occurs when temperatures and humidity are high and sometimes results in reduced yield and test weight.

Conley has outstanding milling and baking properties. It is equal in gluten strength to Thatcher.

Conley has been reported to shatter on occasion.

History.—Conley (C.I. 13157; reg. 388) was developed by the North Dakota Agricultural Experiment Station and the Crops Research Division. The cross [Thatcher × (McMurachy-Exchange × Redman²)] × Lee was made in 1949. Some stem rust resistant plants were found in the F_2 generation at Langdon, N. Dak., in 1950. These were tested as F_3 seedlings and found to be susceptible to 15B. They were tested by inoculation for adult plant reaction and some were resistant. Those resistant were grown at Fargo in 1951, and 29 F_4 rows showing 0 or trace readings were saved. In 1952, 391 F_5 head rows were grown at Fargo and the line later named Conley was selected on the basis of a low stem rust reading. Conley was entered in the Uniform Hard Red Spring Wheat Performance Nursery in 1954 as N.D. 1. The variety was released to certified seed growers by the North Dakota Agricultural Experiment Station in 1955 (*56*).

Distribution.—Conley was grown on an estimated 495,053 acres in 1959, mostly in North Dakota. South Dakota, Minnesota, and Montana had smaller acreages (*91*).

LEE

Description.—Plant spring habit, early, short; stem white, midstrong; spike awned, oblong to fusiform, middense, erect; glumes glabrous, white, long, midwide; shoulders midwide, oblique to rounded; beaks midwide, acuminate, 3 to 10 mm. long; awns white, 2 to 6 cm. long; kernels red, midlong, hard, ovate; germ midsized to large; crease midwide, middeep; cheeks angular; brush midsized, midlong. (See fig. 48, *B*.)

Lee is moderately resistant to leaf rust and resistant to most races of stem rust. It is considered to be susceptible to stem rust race 15B but possesses some degree of tolerance in comparison to other susceptible varieties. It is moderately susceptible to bunt and susceptible to loose smut.

Lee has good milling and baking properties—nearly equal to Thatcher. It tends to be higher than Thatcher in water absorption of the flour, protein content, and test weight. It is about equal to Thatcher in flour yield. It produces bread lower in loaf volume than expected for the protein content. Bread from Lee is superior to that from Thatcher in crumb color and structure.

History.—Lee (C.I. 12488; reg. 364) was developed by the Minnesota Agricultural Experiment Station and the Crops Research Division. It is a selection from the cross Hope × Bobin²-Gaza, made in 1939. The final selection, designated Minn. 2776, was made in 1943. It was entered in the Uniform Spring Wheat Regional Performance Nursery in 1946 and released by the Minnesota Agricultural Experiment Station in 1951. It was licensed in Canada in 1950 (*10, 56*).

FIGURE 48.—*A*, Conley and *B*, Lee common wheats: spikes and glumes, × 1; kernels, × 3.

Distribution.—Lee was grown on an estimated 1,612,030 acres in 1959, mostly in North and South Dakota. It was grown on about 100,000 acres in Montana, and on a small acreage in Minnesota (*91*).

MILAM

Description.—Plant spring intermediate habit, early, short to midtall; stem white, midstrong; spike awned, oblong, middense, erect; glumes glabrous, white, long, midwide; shoulders narrow to wanting, oblique; beaks midwide, acuminate, 2 to 5 mm. long; awns white, 2 to 6 cm. long; kernels red, short, hard, ovate; germ large; crease midwide, middeep; cheeks rounded; brush midsized, midlong.

Milam is resistant to all races of stem rust which were predominant in Texas at the time of its release and has some leaf rust resistance. It was developed in an attempt to reduce overwintering as well as early spring increase of stem rust in the Gulf Coast area of Texas. Milam is susceptible to loose smut.

Because it is not winter hardy, Milam is adapted for fall planting only in south Texas.

Flour from Milam is not as suitable for bread baking as that from good quality commercial varieties, but is an improvement over mixed lots of feed wheat recently grown in south Texas. Milam has mellow to weak gluten.

History.—Milam (C.I. 13369) is a pure line strain from the cross Bowie × Lee. It was one among several selections received from Dr. Norman Borlaug, Rockefeller Foundation, Mexico City, Mexico, in 1953. It was tested extensively for reaction to stem rust in the International Seedling Test Nursery in 1958. Milam was released to certified seed growers in the fall of 1960 by the Texas Agricultural Experiment Station, in cooperation with the Crops Research Division.

RACINE

Description.—Plant winter habit, midseason, midtall to tall; stem purple, weak; spike awned, fusiform, middense to lax, inclined to nodding; glumes glabrous, white, long, midwide; shoulders narrow to wanting, oblique; beaks narrow, acuminate, 2 to 5 mm. long; awns white, 2 to 10 cm. long; kernels red, midlong to long, soft, ovate to elliptical; germ midsized; crease midwide, middeep; cheek rounded; brush midsized to small, midlong.

Racine is moderately resistant to some races of leaf rust and stem rust. It is resistant to loose smut, moderately resistant to bunt, moderately resistant to powdery mildew, susceptible to soilborne mosaic, and susceptible to hessian fly.

Racine is winter hardy and adapted to growing in Wisconsin.

Racine has a softer kernel texture than Blackhawk. Flour of Racine is of satisfactory soft wheat quality.

History.—Racine (C.I. 13172) was developed by the Wisconsin Agricultural Experiment Station from the cross (Gladden × Kansas 500) × (Fultz sel.-Hungarian × Kansas 500). The first crosses were made in 1937 and the final cross was made in 1945. The line X287–1, which became Racine, was tested for loose smut reaction by artificial inoculation in the F_6 generation in 1950. It was grown in rod rows from 1952 through 1955, and entered in the Uniform Eastern Soft Wheat Nursery in 1955. Racine was released to certified growers in 1956 by the Wisconsin Agricultural Experiment Station.

Distribution.—Racine was grown on an estimated 13,248 acres in 1959, nearly all in Wisconsin (*91*).

OTTAWA

Description.—Plant winter habit, early, short; stem white, strong; spike awned, fusiform, middense, inclined; glumes glabrous, brown, midlong, narrow to midwide; shoulders midwide, rounded to oblique; beaks narrow, acuminate, 4 to 8 mm. long; awns white (light brown), 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong. (See fig. 49, *A*.)

Ottawa is resistant to race 56 of stem rust, but not to 15B. It is resistant to the races of leaf rust that were prevalent in Kansas at the time it was released. It is resistant to soilborne mosaic and is particularly adapted for growing in the mosaic infested areas of eastern Kansas. Ottawa is moderately susceptible to loose smut and bunt, and is susceptible to streak mosaic. It is resistant to hessian fly. The source of hessian fly resistance (W38 in the pedigree) is different from that in Pawnee and Ponca.

Ottawa has sufficient winter hardiness for Kansas and shatters less than Pawnee.

Ottawa is a mellow gluten hard wheat, similar to Wichita. It has a somewhat longer mixing time than Pawnee but shorter than Ponca or Comanche.

History.—Ottawa (C.I. 12804) was selected from the cross (Mediterranean-Hope × Pawnee) × (Oro–W38 ×

FIGURE 49.—*A*, Ottawa and *B*, Concho common wheats: spikes and glumes, × 1; kernels, × 3.

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Comanche, F_1), which was made in 1943. The final selection, Ks 49454, was made in 1948 in the F_8 generation. This line segregated for reaction to race 56 of stem rust. A number of stem rust progenies were bulked for increase of what became Ottawa. It was entered in the Uniform Hard Red Winter Wheat Performance Nursery in 1953 and released in 1960 by the Kansas Agricultural Experiment Station in cooperation with the Crops Research and Entomology Research Divisions (*6*).

CONCHO

Description.—Plant winter habit, early to midseason, short to midtall; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, brown, midlong, midwide; shoulders midwide, square to rounded; beaks midwide, acuminate, 5 to 12 mm. long; awns white (light brown), 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized, short to midlong. (See fig. 49, *B*.)

Concho is highly resistant to the races of leaf rust that were predominant in Oklahoma at the time of release but is susceptible to some races that have since become of importance in the Southern Plains States. It is susceptible to stem rust, resistant to bunt and soilborne mosaic, moderately resistant to loose smut, and has a high degree of tolerance to streak mosaic. It is susceptible to hessian fly.

Concho produces grain high in test weight and of satisfactory bread-baking quality. In mixing time and other dough properties it is better than Pawnee but inferior to Comanche.

Concho is superior to Ponca in winter hardiness, but does not equal Pawnee.

History.—Concho (C.I. 12517; reg. 351) was developed from a cross of Comanche with a pure line selection of Blackhull × Hard Federation, made in 1937 at the U.S. Southern Great Plains Field Station, Woodward, Okla. From 1937 through 1946 (F_1 through F_9 generations) it was grown continuously at Woodward. Head selections were made in the F_6 generation and grown in head rows in 1944. The first yield test of the line that became Concho was made in 1946. It was grown in a Stillwater, Okla., yield nursery in 1947, as well as in a greenbug nursery and in the Uniform Regional Bunt Nursery. In 1949 it was entered in the Uniform Regional Performance Nursery. Concho was released in the fall of 1954 by the Oklahoma Agricultural Experiment Station. It was developed cooperatively with the Crops Research Division (*102*).

Distribution.—Concho was grown on an estimated 1,225,657 acres in 1959, principally in Oklahoma, Texas, and Kansas (*91*).

ITANA

Description.—Plant winter habit, midseason, midtall to tall; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, brown (few brown and black), short, narrow to midwide; shoulders midwide, square to rounded; beaks midwide, acute, 0.5 to 1.0 mm. long; awns white (light brown), 2 to 8 cm. long; kernels red, short, hard, ovate; germ midsized to small; crease midwide, shallow; cheeks rounded; brush midsized to large, midlong. (See fig. 50, *A*.)

Itana is resistant to the races of bunt and dwarf bunt that were prevalent in the Pacific Northwest at the time of release. Bunt and dwarf bunt have been reported in Itana since that time. It is susceptible to stem rust, leaf rust, and stripe rust.

Except for damage by snow mold, winter hardiness of Itana has been ample for dryland production in the Pacific Northwest.

In milling and baking quality Itana is superior to Wasatch, Cache, and Turkey. In test weight, it is equal to the same varieties or higher (*42*).

History.—Itana (C.I. 12933) was developed from a cross of Blackhull-Rex × Cheyenne. The cross was made at the Sherman Branch Experiment Station, Moro, Oreg., in 1942. The selection later named Itana was made in 1948 at Moro and assigned the designation M 482296. It was entered in the Western Uniform Hard Red Winter Wheat Nursery in 1951. A reselection from head rows was grown at Moro and at Lind and Pullman, Wash., in 1954. Itana was widely tested in Montana and Idaho. It was released by the Montana Agricultural Experiment Station in 1956, and by the Idaho Agricultural Experiment Station in 1957 (*42*).

Distribution.—Itana was grown on an estimated 36,731 acres in 1959, mostly in Montana and Idaho (*91*).

COLUMBIA

Description.—Plant winter habit, midseason, short; stem white, midstrong; spike awned, fusiform, middense, inclined; glumes glabrous, brown, short, narrow; shoulders narrow to midwide, rounded to oblique; beaks narrow, acuminate, 3 to 5 mm. long; awns white (light brown), 2 to 8 cm. long; kernels red, short, hard, ovate; germ midsized; crease narrow to midwide, shallow;

FIGURE 50.—*A*, Itana and *B*, Tascosa common wheats: spikes and glumes, × 1; kernels, × 3.

cheeks rounded; brush midsized, midlong.

Columbia is resistant to the races of bunt and dwarf bunt that were predominant in the Pacific Northwest at the time it was released; it has since proved susceptible to one race of dwarf bunt. It is susceptible to leaf rust, stem rust, and stripe rust.

Columbia equals Rio in winter hardiness and is best adapted to the 8- to 12-inch rainfall areas of the Pacific Northwest.

Columbia is a good quality hard wheat with test weight equal to that of Rio. The flour has a long mixing time. When grown in the higher rainfall areas, protein content is often too low for production of good quality flour.

History.—Columbia (C.I. 12930; reg. 370) was selected from the cross Rio-Rex × Nebred made in 1942 at the Sherman Branch Experiment Station, Moro, Oreg. Progenies of the cross were carried in bulk with mass selection for bunt resistance. Head row selections were grown in 1948, and the line later named Columbia was designated as M 482215. It was entered in the Uniform Western Hard Red Winter Wheat Nursery in 1951. Reselections were made in 1953 and about 300 uniform head rows were bulked to form breeders' seed. Columbia was released in 1955 by the Oregon and Washington Agricultural Experiment Stations (*42*, *51*, *56*).

Distribution.—Columbia was grown on an estimated 164,799 acres in 1959, mostly in Washington. Smaller acreages were grown in Idaho and Oregon. (*91*).

TASCOSA

Description.—Plant winter habit, early, short; stem white, strong; spike awned, oblong to fusiform, middense, erect to inclined; glumes glabrous, brown, midlong, midwide; shoulders wide, square; beaks midwide, acuminate, 2 to 4 mm. long; awns white (light brown), 2 to 8 cm. long; kernels red, midlong, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, short. (See fig. 50 *B*.)

Tascosa is susceptible to leaf and stem rust, and to bunt. It is moderately susceptible to loose smut. It is moderately resistant to soilborne mosaic and stripe rust.

Tascosa is not as winter hardy as Comanche but is sufficiently hardy for Texas conditions. The kernels are held tightly by the glumes and special setting of concaves during the threshing operation may be necessary.

Tascosa has good milling and baking characteristics. Its mixing time is long. Particularly outstanding is its high test weight.

History.—Tascosa (C.I. 13023; reg. 404) was developed cooperatively by the Texas Agricultural Experiment Station and the Crops Research Division from a cross of (Kanred-Hard Federation-Tenmarq × Mediterranean-Hope) × Cimarron. The final cross was made at Denton, Tex., in 1945. The progenies were grown in bulk populations for several years at Denton and Bushland. The line 274-51-A7, later named Tascosa, was selected at Bushland in 1951. It was entered in the Regional Performance Nursery in 1955, and released by the Texas Agricultural Experiment Station to certified seed growers in the fall of 1959 (*4*).

WESTMONT

Description.—Plant winter habit, early to midseason, midtall; stem white, midstrong; spike awned, oblong to fusiform, middense, inclined; glumes glabrous, brown, midlong, narrow to midwide; shoulders midwide, square to rounded; beaks midwide, acuminate, 3 to 8 mm. long; awns white (light brown), 2 to 7 cm. long; kernels red, short, hard, ovate; germ midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong.

Westmont was resistant to the races of dwarf bunt which prevailed in that part of Montana west of the Continental Divide at the time it was released; it has since proved susceptible to one race. It is susceptible to stem rust, leaf rust, and stripe rust, and resistant to common bunt.

Westmont is sufficiently winter hardy to be grown in the Intermountain areas of western Montana.

Westmont is satisfactory for production of flour for bread baking.

History.—Westmont (C.I. 12930) is a sister selection of Columbia, both from the cross Rio-Rex × Nebred, which was made in 1942 at the Sherman Branch Experiment Station, Moro, Oreg. Progenies were propagated in a bulk hybrid population with mass selection for smut resistance. Head selections were made in 1948 and the one that became Westmont was designated as M 482235. It was entered in the Uniform Western Hard Red Winter Wheat Performance Nursery in 1951. Westmont performed well in the Montana locations where the Regional Nursery was grown. Further evaluation followed in the Montana Intrastate Nursery. Westmont was released by the Montana Agricultural Experiment Station in 1956.

Distribution.—Westmont was grown on an estimated 22,508 acres in 1959, essentially all in Montana (*91*).

RODCO

Rodco is a mixture of two components, each of which is treated separately in the description.

Description.—Component 1 (white chaff plants): Plant winter habit, midseason, short to midtall; stem white, midstrong; spike awned, fusiform, middense, erect; glumes glabrous, white, midlong, midwide; shoulders midwide, square; beaks midwide, acuminate, 6 to 15 mm. long; awns white, 2 to 8 cm. long; kernels red, short, hard, ovate; germ small to midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong.

Description.—Component 2 (brown chaff plants): Plant winter habit, early to midseason, short to midtall; stem white, midstrong; spike awned, fusiform, middense (slightly less dense than component 1), inclined; glumes glabrous, brown, midlong, midwide; shoulders midwide, square; beaks narrow, acuminate, 7 to 12 mm. long; awns white (light brown), 2 to 8 cm. long; kernels red, short (slightly longer than component 1), hard, ovate; germ small to midsized; crease midwide, shallow; cheeks rounded; brush midsized, midlong.

Rodco is variable for stem rust, leaf rust, bunt, and loose smut reaction. Progeny from component 1 have resistance to hessian fly and to some races of leaf and stem rust, and are very susceptible to loose smut. Progeny from component 2 are susceptible to stem and leaf rust and are resistant to the same races of loose smut as Concho (*57*). Rodco is similar to Concho for reaction to two virus diseases, having a high degree of tolerance to wheat streak mosaic and resistance to soilborne mosaic.

From the original lot of seed grown in the Wheat Classification Nursery, approximately 60 percent of the plants had white chaff and were very similar to C.I. 12406, a good quality hard wheat experimental line that was never released. About 40 percent of the plants had brown chaff and closely resembled Concho. When grown over a period of time the proportion of the white glume component to the red glume component would be expected to vary with the influence of environment, depending on location and seasonal conditions.

Rodco has strong mixing and other physical dough properties.

History.—Rodco (C.I. 13560) was distributed by the Rodney Milling Company, Sterling, Kans., about 1957. It corresponds closely to and is believed to be a mixture of C.I. 12406 and Concho. It was grown in the Uniform Plot Series by the Kansas Agricultural Experiment Station in 1959.

Distribution.—Rodco was grown on an estimated 25,771 acres in 1959, all in Kansas (*91*).

MISCELLANEOUS VARIETIES OF COMMON WHEAT

Some varieties that have not been previously described and are grown to a very limited extent in the United States are included under miscellaneous varieties. These do not appear in the key (pp. 59–63). Complete information is not available on all those included.

AVOCA

Avoca (C.I. 13395) is a hard red winter wheat. It is midseason in maturity; has short, white, midstrong straw; and has an awned, fusiform, middense, inclined spike. Glumes are glabrous, white, midlong, and narrow to midwide. Shoulders are midwide and square. Beaks are narrow, acuminate, and 2 to 5 mm. long. Awns are white and range from 2 to 9 cm. long. Avoca kernels are red, midlong, hard, and ovate. The germ is midsized; crease midwide and shallow; cheeks rounded; and the brush midsized, and midlong to short.

Avoca is susceptible to leaf rust, stem rust, and soilborne mosaic. It is quite tolerant to wheat streak mosaic.

Avoca produces grain of high test weight but has mellow gluten and a short mixing time.

Avoca was developed by a private plant breeder, Mr. Joseph Danne of El Reno, Okla. A hybrid from the cross [Triumph × (Danne Beardless-Blackhull) ×

(Kanred-Blackhull × Florence)]² × Florence-Reliant was crossed with a hybrid from the cross (Kanred-Blackhull H59C × Triumph) × [(Danne Beardless-Blackhull) × (Kanred-Blackhull × Florence)] in 1940. The selection named Avoca, C69–40–1–9, was distributed by Mr. Danne in 1954.

Avoca was reported grown on a small acreage (928 acres) in 1959 in Oklahoma and Texas (*91*).

C.T. 231

C.T. 231 (C.I. 13221) is a hard red spring wheat. It is early in maturity; has short to midtall, white, midstrong straw; and has an awned, oblong, middense, erect to inclined spike. Glumes are glabrous, white, long, and wide. Shoulders are midwide and square to rounded (few elevated). Beaks are midwide, acuminate, and 3 to 5 mm. long. Awns are white and range from 2 to 7 cm. long. C.T. 231 kernels are red, midlong, hard, and ovate. The germ is midsized; crease midwide and middeep; cheeks rounded; and the brush midsized and midlong.

C.T. 231 is very similar to Lee except for stem rust resistance. It has some resistance to some cultures of race 15B, but is more susceptible than Selkirk. It is more leaf rust resistant than Selkirk.

C.T. 231 is low in test weight and flour yield. It is poor to fair in bread-baking quality and only fair in milling quality. C.T. 231 has short mixing time.

C.T. 231 is a selection from Lee[6] × Kenya Farmer. It was developed by the Rust Area Project Group, Canada Department of Agriculture Research Station, Winnipeg, Manitoba, Canada. It was entered in the Uniform Hard Red Spring Performance Nursery in 1956. Because of inferior quality, C.T. 231 was not licensed for sale in Canada nor released or recommended by any experiment station in the United States.

C.T. 231 was grown on an estimated area of 41,273 acres in 1959. Approximately ⅔ of the acreage was in North Dakota and ⅓ in South Dakota (*91*).

DRUCHAMP

Druchamp (C.I. 13723) is a soft white common winter wheat. It has short, strong straw and an awnleted, oblong, middense to dense spike. Glumes are glabrous, white, long, and wide. Shoulders are wanting to very narrow and oblique. Beaks are midwide, obtuse, and 1 mm. long. Awnlets are white and range from 2 to 12 mm. long. Druchamp kernels are white, midlong, soft, and ovate to oval. The germ is midsized; crease midwide to wide and middeep; cheeks rounded; and the brush large and midlong.

Druchamp is resistant to stripe rust. Reaction to other wheat diseases and evaluation of quality are not available.

Druchamp was introduced into the United States from France in 1949. It was developed in France from the cross Vilmorin 27 × Fleche d'Or.

It was grown on an estimated 16,850 acres in 1959, essentially all in Oregon (*91*).

IOWIN (HARVEYLAND)

Harveyland (C.I. 13364) is considered to be a synonym for Iowin (C.I. 10071). Harveyland was named after Harvey County in Kansas. It has not been officially released under this name, nor recommended.

Iowin (Harveyland) is a hard red winter wheat. It is midseason to late in maturity; has midtall, white, weak straw (about one-

fourth of the plants have purple straw); and has an awned, fusiform, middense to lax, inclined to nodding spike. Glumes are glabrous, white, midlong, and midwide. Shoulders are narrow to midwide and square to rounded. Beaks are midwide, acuminate, and 6 to 20 mm. long. Awns are white and range from 2 to 10 cm. long. Iowin (Harveyland) kernels are red, midlong, hard, and elliptical. The germ is midsized to large; crease midwide, middeep; cheeks rounded; and the brush midsized and midlong.

Iowin (Harveyland) is susceptible to stem rust and resistant to leaf rust. It is very susceptible to soilborne mosaic, and is susceptible to loose smut, bunt, streak mosaic, and hessian fly.

Iowin (Harveyland) is winter hardy enough to be grown in Kansas and Iowa. It has weak straw and tends to lodge.

Iowin (Harveyland) has a long mixing time and is a good quality hard wheat.

It has been grown in central Kansas for many years. The original seed reportedly came from Iowa about 1932, where it had been grown by a farmer who obtained it as certified seed. He did not retain the identity.

KANKING

KanKing (C.I. 12719) is a hard red winter wheat. It is very early in maturity; has midtall to tall, white, midstrong straw; and has an awned, fusiform, middense, inclined spike. Glumes are glabrous, brown with black markings, short (about the same length as the kernels), and midwide. Shoulders are midwide and square to rounded. Beaks are midwide, acute, and 1 to 2 mm. long. Awns are brown and black and range from 2 to 6 cm. long. KanKing kernels are red, midlong, hard, and ovate. The germ is small; crease midwide and shallow; cheeks rounded; and the brush small and short. KanKing resembles RedChief, but is awned and several days earlier.

KanKing is susceptible to leaf rust, stem rust, bunt, loose smut, and soilborne mosaic. It has some tolerance to streak mosaic. It is susceptible to hessian fly.

KanKing is well adapted for growing in Kansas, Oklahoma, and Texas, being winter hardy enough for that area.

KanKing has unsatisfactory quality characteristics for a hard wheat. It has an attractive, hard textured kernel, high in test weight, but has short mixing time and low loaf volume.

KanKing was developed by Mr. Earl G. Clark of Sedgwick, Kans. It is believed to be a selection from the cross Pawnee × RedChief or from the cross (Comanche × Marquillo-Oro, F_1) × (RedChief-Nebred, F_1). The Kansas Agricultural Experiment Station sent F_3 bulk seed of several crosses to Mr. Clark in 1945. He selected one plant (an F_3) in 1946 and increased it. KanKing was distributed by Mr. Clark in 1952.

KanKing was grown on an estimated 12,981 acres in 1959, nearly all in Texas and Oklahoma (*91*).

SuperKing is a synonym of KanKing.

WINALTA

Winalta (C.I. 13670) is a hard red winter wheat about as winter hardy as Kharkof 22MC, but is earlier in maturity and has shorter straw. It has an awned, fusiform, middense spike. Glumes are glabrous and white. Shoulders are narrow and oblique. Beaks range from 2 to 7 mm. long. Winalta kernels are red and hard.

Winalta is susceptible to bunt, leaf rust, and stem rust.

Winalta has excellent milling quality. Baking quality approaches that of the Canadian hard red spring varieties.

Winalta was selected from a cross between Minter and Wichita. The cross was made at Lethbridge, Alberta, Canada, in 1949. The selection which became Winalta was tested in the winter wheat yield trials from 1956 through 1960. It was licensed for release in Canada in 1961.

CLUB WHEAT

The plants of club wheat may be either winter or spring habit and either tall or short. The stems usually are stiff and strong.

The spikes usually are awnless and are elliptical, oblong, or sometimes clavate or club shaped, short, usually less than 2½ inches in length, very compact, and laterally compressed. They have a tough rachis which does not disarticulate.

The spikelets usually contain five fertile florets and spread at nearly a right angle to the rachis.

The kernels are free-threshing and are small and laterally compressed or "pinched" because of crowding in the compact spikes. Most club wheat kernels have a small, short brush and a narrow, shallow crease. The grain may be either white or red and that of most varieties is very soft in texture. It is used largely for cake and pastry flours.

Club wheats are distinguished from common wheats by the shorter and denser, laterally compressed spikes.

KEY TO VARIETIES

1a. Spike awnleted.
  2a. Glumes white.
    3a. Kernels white.
      Kernels short to midlong.
        Kernels soft.
          Winter habit.
            Plant midtall.

		Page
Shoulders wanting to narrow, oblique	ELGIN	117
	ELMAR	117

          Spring habit.
            Plant midtall to tall.

Shoulders midwide, rounded	BIG CLUB 60	117

  2b. Glumes brown.
    3a. Kernels white.
      Kernels short to midlong.
        Kernels soft.
          Winter habit.
            Plant midtall.

Shoulders narrow, oblique	OMAR	117

1b. Spike awned.
  2a. Glumes white.
    3b. Kernels red.
      Kernels short to midlong.
        Kernels semihard.
          Winter habit.
            Plant midtall.

Shoulders wanting to narrow, oblique	SPOKANE CHIEF	119

DESCRIPTION, HISTORY, AND DISTRIBUTION OF VARIETIES

ELGIN

Description.—Plant winter habit, midseason, midtall; stem white, very strong; spike awnleted, elliptical, very dense, erect; glumes glabrous, white, short, narrow to midwide; shoulders wanting to narrow, oblique; beaks midwide, obtuse, 0.5 mm. long; awnlets white, 1 to 5 mm. long; kernels white, short, soft, ovate; germ small to midsized; crease narrow, shallow; cheeks rounded; brush midsized, midlong.

Elgin is susceptible to stripe rust, leaf rust, stem rust, bunt, and powdery mildew.

Elgin is similar to Omar, Brevor, and Burt in winter hardiness. It is so similar to Alicel in all characteristics, except for a mixture of white and purple stems in Alicel, that the two are considered synonymous.

Elgin has excellent soft wheat milling and baking quality.

History.—Elgin (C.I. 11755) is a selection from Alicel, made in 1932 at the Pendleton Branch Experiment Station, Pendleton, Oreg. It is more uniform than Alicel in plant height and color of straw. It was entered in the western region Uniform White Winter Wheat Performance Nursery in 1936. Elgin was distributed from the Sand Point, Idaho, Agricultural Experiment Station in 1942 and from the Pendleton Branch and Sherman Branch Agricultural Experiment Stations in Oregon in 1943.

Distribution.—Elgin was grown on an estimated 158,714 acres in 1959 in Washington and Oregon—principally in Washington (*91*).

Synonym.—Alicel.

ELMAR

Description.—Elmar is practically identical to Elgin in performance, morphologic characters, and quality.

Elmar has resistance to some races of bunt. It is susceptible to stripe rust, leaf rust, stem rust, and powdery mildew.

It is similar in winter hardiness to Burt, Omar, and Brevor. All are less hardy than most Turkey-type hard red winter wheats.

Elmar is similar to Elgin in milling behavior and in baking quality.

History.—Elmar (C.I. 12392; reg. 387) was developed from a cross of Hymar-Elgin backcrossed twice to Elgin. The first cross was made in 1942 and the backcrosses were made in 1943 and 1944 at Pullman, Wash. The most bunt resistant F_3 progeny was selected in 1946 and entered in the Western Uniform Winter Wheat Performance Nursery in 1948. Elmar was released in the fall of 1949 by the Washington Agricultural Experiment Station. The variety was distributed also by the Idaho and Oregon Agricultural Experiment Stations that same year. Elmar was developed cooperatively by the Washington Agricultural Experiment Station and the Crops Research Division (*10*).

Distribution.—Elmar was grown on an estimated 124,142 acres in 1959, mostly in Washington and Oregon (*91*).

BIG CLUB 60

Description.—Plant spring habit, midseason, midtall to tall; stem purple, strong, peduncle curved; spike awnleted, elliptical to clavate, dense, erect; glumes glabrous, white, midlong, midwide; shoulders midwide, usually rounded; beaks wide, obtuse, 0.5 mm. long; awnlets white, 2 to 5 mm. long; kernels white, short, soft, nearly oval; germ small; crease narrow, shallow; cheeks usually angular; brush small, midlong. Big Club 60 is indistinguishable from Big Club 43 except for the purple straw of Big Club 60.

Big Club 60 has some stem rust resistance (equal to that of Baart 46), and is susceptible to leaf rust and powdery mildew. It is resistant to races of bunt and of hessian fly common to California. It has more resistance to yellow dwarf than does Big Club 43.

Limited data indicate that Big Club 60 is very similar in quality to Big Club 43.

History.—Big Club 60 (C.I. 13643) was developed cooperatively by the California Agricultural Experiment Station and the Crops Research Division. A single F_3 line from the development of Big Club 43, which had been rejected in 1943 because of its purple straw, was backcrossed to Big Club 43 and selected on the basis of stem rust resistance. In 1960, 103 F_4 lines were bulked for breeders' seed. Registered seed was produced in 1961–62. Big Club 60 was released by the California Agricultural Experiment Station in 1962.

OMAR

Description.—Plant winter habit, midseason to late, midtall; stem white, strong; spike awnleted, elliptical, very dense, erect; glumes glabrous, brown, midlong, midwide; shoulders narrow, oblique; beaks midwide, obtuse, 0.5 mm. long; awnlets white (light brown), want-

ing to 10 mm. long; kernels white, short, soft, ovate; germ small; crease midwide, shallow; cheeks rounded; brush midsized, midlong to short. (See fig. 51, *A*.)

Omar is susceptible to leaf and stem rust, powdery mildew, and stripe rust. It is resistant to the races of bunt that were known at the time of release.

Under favorable growing conditions Omar is slightly taller and later than Elgin. It was developed to replace Elmar, Elgin, and Hymar in the higher rainfall wheat growing areas of the Pacific Northwest.

It is comparable to Burt, Brevor, and Elmar in winter hardiness, but is not as hardy as the Turkey-type hard red winter varieties.

Omar has excellent soft wheat milling and baking properties.

History.—Omar (C.I. 13072; reg. 377) was developed from a cross made in 1947 between Elgin 19 and Elmar. The pedigree of Elgin 19 is (Oro × Turkey-Florence) × Elgin[3]. Elmar is Hymar

FIGURE 51.—*A*, Omar and *B*, Spokane Chief club wheats: spikes and glumes, × 1; kernels, × 3.

X Elgin[3]. The objective of the cross was to combine the bunt resistance factors of both parents in an Elgin-type wheat with the brown chaff color of Elgin 19. In 1953 the best appearing smut-free F_6 lines were put in yield trials at Pendleton, Oreg., and Pullman, Wash. After selection, 23 lines were again grown at these locations in 1954. After testing in the Uniform Red Chaff Club Nursery, in Washington and Oregon in 1954 and 1955, Selections 114, 136, and 140 were composited to furnish seed stocks to release under the name Omar. Selection 140 had such a consistently high yield record that it was chosen as a source for all seed stocks after the initial release. Selection 140 traces back to a single F_3 plant. It was grown (along with selections 114, 136, and 149) in the Western Uniform White Wheat Nursery in 1955. Omar was released in the fall of 1955 by the Washington, Oregon, and Idaho Agricultural Experiment Stations. It was developed cooperatively by the Washington Agricultural Experiment Station and the Crops Research Division (*120*).

Distribution.—Omar, the leading white wheat in the United States in 1959, was grown on 1,537,310 acres. Practically all of it was in Washington, Oregon, and Idaho (*91*).

SPOKANE CHIEF

Description.—Plant winter habit, midseason, midtall; stem white, midstrong; spike awned, elliptical, dense, erect; glumes glabrous, white, midlong to long, midwide; shoulders wanting to narrow, oblique; beaks midwide, acuminate, 3 to 5 mm. long; awns white, 2 to 6 cm. long; kernels red, short, semihard, ovate to elliptical; germ midsized to small; crease midwide, middeep; cheeks rounded; brush midsized to small, midlong. (See fig. 51, *B*.)

Spokane Chief is susceptible to most races of bunt. Little is known about its reaction to other diseases, except that it is susceptible to leaf rust.

Spokane Chief has poor soft wheat milling and baking quality. It does not have as hard a kernel texture as Turkey.

History.—Spokane Chief (C.I. 13252) is a selection of club wheat from a field of Oro. Mr. Hugh I. Morrow, of Cheney, Wash., selected three heads and increased seed from them. He named the variety in 1953 and distributed seed.

No acreage was reported grown in 1959 (*91*).

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INDEX TO VARIETIES, SPECIES, AND SUBSPECIES

Recognized variety names are in capital letters; varietal synonyms are in capitals and lowercase letters. Species or subspecies names are in italic capital letters.

The C.I. number and class of wheat are listed for each variety or synonym (except for a few which have no C.I. number assigned).

Page references are listed for varieties. One refers to the key and the other to the description, history, and distribution. Each page reference given for a synonym is to the recognized variety for which the name is a synonym.

*Usually has semihard to hard kernel texture.

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APPENDIX: WHEAT VARIETY NAME ABBREVIATIONS

The National Wheat Improvement Committee[4] adopted a procedure for abbreviating wheat variety names. The method of assigning abbreviations is based on major and minor syllabic divisions of a name (*14*).

Abbreviations have been assigned to 521 varieties which are of commercial interest or are of use in United States wheat breeding programs.

Variety names consisting of 4 letters or less are not abbreviated, so are not listed. Names are arranged in alphabetical order.

[4] The National Wheat Improvement Committee membership includes the Chairman and Secretary of each of the four Wheat Improvement Workers' Conferences (Hard Red Winter Wheat Region, Hard Red Spring Wheat Region, Western Region, and the Eastern Soft Wheat Region), and the Head of Wheat Investigations, Crops Research Division.

Variety name	*Abbreviation*	*C. I. No.*
Aegilops umbellulata.	*Au*	------
Agropyron elongatum.	*Ae*	------
Agrus	Ars	13228
Akrona	Ar	6881
Alaska	Als	5988
Albit	Ab	8275
Alicel	Aic	11700
Allen	Al	5407
Alstroum (Spelt)	As	1773
Alton	At	1438
American Banner	AB	6943
Anderson	Ad	12536
Aniversario	Aiv	------
Apache	Ap	12122
Arcadian (Early Arcadian).	Ac	5536
Ariette	Ai	6243
Arnautka	An	1494
Ashkof	Ak	6680
Ashland	Aln	6692
Asosan	Asn	12665
Athena	Ath	11693
Atlas 50	Atl 50	12534
Atlas 66	Atl 66	12561
Austin	Atn	12346
Avoca	Av	13395
Awned Onas	AO	12235
Axminster	Am	8195
Aztec	Atc	13016
Baart	Bt	1697
Baart 38	Bt 38	11907
Baart 46	Bt 46	12386
Bacska	Bs	6156
Baldrock	Br	11538
Baldwin	Bw	6271
Barnatka	Bn	8214
Bearded Winter Fife.	BWF	6401
Beloglina	Bo	1667
Berkeley Rock	BR	8272
Big Club	BC	4257
Big Club 37	BC 37	11901
Big Club 43	BC 43	12244
Big Club 60	BC 60	13643
Big Frame	BF	6184
Bison	Bsn	12518
Blackhawk	Bhk	12218
Blackhull	Bh	6251
Black Winter (emmer).	BW	------
Bledsoe	Bds	13238
Bluechaff	Bc	5256
BlueJacket	BJ	12502
Bobin	Bbn	11194
Bowie	Bi	13146
Brevit	Bv	3778
Brevor	Bvr	12385
Brill	Bl	11853
Buffum No. 17	Bf 17	4706
Buford (durum)	Bfr	------
Bunyip	By	5125
Butler	Blr	12527
Cache	Ch	11599
Cadet	Cd	12053
Canadian Red	CR	6282
Canawa	Caw	11854
Canthatch	Cth	13345
Canus	Cs	11637
Carala	Cal	12184
Carina	Ci	3756
Carleeds	Cld	11801
Carleton	Ctn	12064
Cascade	Ccd	12376
Centana	Cnt	12974
Centenario	Ctr	12021
Ceres	Crs	6900
Challenge	Cl	2523
Champlain	Cpl	4782
Chancellor	Cc	12333
Cheyenne	Cnn	8885

Variety name	*Abbreviation*	*C. I. No.*
Chiefkan	Cfk	11754
China	Cn	180
Chinese	Cns	6223
Chinook	Cnk	13320
Cimarron	Crr	12120
Clackamas	Ca	7351
Clarendon 2202	Cnd 2202	------
Clarkan	Ckn	8858
Climax	Cm	6203
Coastal	Ctl	12463
Coker 47–27	Ck 47–27	12563
Colorado No. 50	Co 50	4959
Colorow	Cor	12865
Colotana	Clt	13556
Columbia	Clm	12928
Comanche	Cmn	11673
Comet	Ct	11465
Concho	Cch	12517
Conley	Cly	13157
Contender	Ctd	13378
Converse	Cv	4141
Cooperatorka	Cpr	8861
Coppei	Cp	3088
Cornell 595	Cnl 595	12372
Coronation	Con	11475
Crockett	Ctt	12702
Currawa	Crw	4982
Currell	Cr	3326
Cypress	Cps	13344
Dakota	Dk	------
Dawson	Ds	3342
Defiance	Df	6477
Delmar	Dm	13442
Democrat	Do	3384
Denton	Dt	8265
Diamond Grit	DG	------
Dicklow	Dl	3663
Diehl-Mediterranean.	DM	1395
Dietz	Dz	4862
Dixon	Dn	6049
Druchamp	Dc	13723
Dular	Dlr	13373
Eagle Chief	EC	8868
Early Blackhull	EB	8856
Early Defiance	ED	6480
Early Premium	EP	11858
Early Red Fife	ERF	4932
Eaton	Et	4682
Eickmeyer	Em	12035
Elgin	Eg	11755
Elmar	Emr	12392
Emerald	Er	4397
Enigma	En	13396
Erect	Erc	11544
Erivan	Ei	2397
Escondido	Ec	8240
Eureka	Ee	12083
Exchange	Ech	12635
Fairfield	Ff	12013
Federation	Fr	4734
Federation 41	Fr 41	12230
Fleming	Fng	5996
Flint	Fnt	6307
Flomar	Fm	11707
Florence	Fn	4170
Foisy	Fs	5246
Forward	Fw	6691
Fretes	Ft	1596
Frisco	Fsc	13106
Frondoso	Fd	12078
Frontana	Ftn	12470
Fronteira	Ftr	12019
Fulcaster	Fc	4862
Fulhio	Fh	6999
Fultz	Fz	1923
Fultzo-Mediterranean.	FM	4811
Gaines	Gns	13448
Galgalos	Gg	2398
Garnet	Gnt	8181
Gasser	Gsr	13289
Gasta	Gst	11398
Genesee	Ge	12653
Genesee Giant	GG	1744
Genro	Gr	11535
Georgia 1123	Gg 1123	13292
Ghirka	Gk	1517
Gipsy	Gs	3436
Gladden	Gdn	5644
Gluten B86	Gt B86	3427
Glyndon	Gd	2873
Goens	Gn	4857
Goldcoin	Gc	4156
Gold Drop	GD	6316
Golden	Gln	11063
Golden Ball	GB	6227
Golden Cross	GC	5180
Grandprize	Gp	4876
Great Northern	GN	11937
Greeson	Gsn	6320
Gypsum	Gsm	4762
Hard Federation	HF	4733
Hard Federation 31.	HF 31	8255
Hardired	Hi	12411
Hard Red Calcutta.	HRC	-------
Harvest Queen	HQ	5314
Harveyland	Hv	13364
Haynes Bluestem	HB	2874
Henry	Hry	12265
Hohenheimer	Hh	11458
Homer	Hm	6328
Honor	Hnr	6161
Humpback	Hb	3690
Hungarian	Hrn	4830
Huron	Hr	*4935
Hussar	Hs	4843
Huston	Ht	5208

*Only the latest assigned C.I. number is listed for varieties that have more than one C.I. number.

Variety name	*Abbreviation*	*C. I. No.*
Hybrid 63	Hbr 63	4510
Hybrid 123	Hbr 123	4511
Hybrid 128	Hbr 128	4512
Hybrid 143	Hbr 143	4160
Hymar	Hmr	11605
Hyper	Hp	8875
Idaed	Idd	11706
Idaed 59	Idd 59	13631
Illini Chief	IC	5406
Illinois No. 2	Il 2	11537
Ilred	Ir	8219
Imperial Amber	IA	5338
Improved Triumph.	IT	13667
Indian	Id	4489
Iobred	Iob	6934
Iohardi	Ioh	12510
Ioturk	Iot	11388
Iowa No. 404	Io 404	5580
Iowa 1946	Io 1946	6676
Iowin	Iow	10017
Itana	It	12933
Jenkin	Jk	5177
John Brown	JB	4121
Jones Fife	JF	4468
Juanita	Jn	------
Jumbuck	Jb	4608
Justin	Jt	13462
Kahla	Khl	5529
Kancom	Kc	13362
KanKing	KK	12719
Kanqueen	Kq	12762
Kanred	Kr	5146
Karmont	Km	6700
Karnvor	Kvr	13347
Kawvale	Kv	8180
Kenhi	Kh	13268
Kentana 52	Kt 52	13085
Kenya Farmer	KF	12880
Kenya Gular	KG	------
Kenya 117A	Ky 117A	12568
Khapli (emmer)	Kl	4013
Khapstein	Kst	13579
Kharkof	Kk	1442
Kinney	Kn	5189
Kiowa	Ko	12133
Kitchener	Ke	4800
Klein Titan	KT	12615
Kofod	Kf	6969
Komar	Kmr	8004
Kruse	Ks	11524
Kubanka	Kb	1440
Kubanka No. 8	Kb 8	4063
Ladoga	Ld	4795
Lakota	Lk	13335
Langdon	Ldn	13165
LaPorte	LP	12557
La Prevision 25	LPr 25	12596
Laramie	La	6235
Lathrop	Lt	13457
Leapland	Ll	11762
Lemhi	Lmh	11415
Lemhi 53	Lmh 53	13068
Lerma 50	Lm 50	------
Lerma Rojo	LR	13651
Little Club	LC	4066
Lofthouse	Lh	3275
Longberry No. 1	Lb 1	5823
Loros	Ls	3779
Lucas	Lc	12990
Mackey	Mk	10028
Major	Mj	4984
Malakof	Ma	4898
Mammoth Red	MR	2008
Marfed	Mf	11919
Maria Escobar	ME	------
Marmin	Mm	11502
Marouani	Mr	1593
Marquillo	Mql	6887
Marquis	Mq	3641
Marsters 46	Mst 46	------
Martin	Mt	4463
Marvel	Mvl	8876
Mayview	Mv	6239
McMurachy	MM	11876
Mealy	My	3358
Mediterranean	Mi	5303
Mentana	Mta	12448
Mexican Bluestem	MB	6004
Michigan Amber	MA	*11770
Michikof	Mik	6990
Milam	Ml	13369
Mindum	Md	5296
Minhardi	Mh	5149
Minter	Mnt	12138
Minturki	Mtr	6155
Missouri Valley	MV	10046
Moking	Mkn	12556
Monad	Mn	3320
Monon	Mnn	13278
Montana King	MK	8878
Montana No. 36	Mtn 36	5549
Mosida	Mid	6688
Nabob	Nbb	8869
Nebraska No. 6	Nb 6	6250
Nebraska No. 28	Nb 28	5147
Nebraska No. 60	Nb 60	6250
Nebred	Nbr	10094
New Amber Longberry.	NAL	------
Newcaster	Nc	12528
Newest Improved Triumph.	NIT	13668
Newsar	Ns	12530
Newthatch	Nth	12318
Newturk	Nt	6935
New Zealand	NZ	6011
Nigger	Ng	5366
Nittany	Ntn	6962
Nodak	Nd	6519

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Variety name	*Abbreviation*	*C. I. No.*
Norin 10	Nrn 10	12699
Norka	Nk	4377
Nudel	Ndl	12672
Nugget	Ngt	12620
Nured	Nr	12455
Oakley	Ol	6301
Oatka Chief	OC	1985
Odessa	Od	4475
Omaha	Om	13015
Ontario Wonder	OW	3483
Oregon Zimmerman.	OZ	7359
Orfed	Of	11913
Orienta	Or	12522
Ottawa	Ot	12804
Pacific Bluestem	PB	4067
Pacific Bluestem 37.	PB 37	11903
Palisade	Pi	4798
Pawnee	Pn	11669
Peliss	Ps	1584
Pembina	Pb	13332
Pennoll	Pnl	12755
Penquite	Pq	11399
Pentad	Ptd	3322
Pesterboden	Ptr	------
Peterson	Pt	------
Pilcraw	Pc	5540
Pilot	Plt	11428
Pioneer	Po	4324
Ponca	Pnc	12128
Poole	Pl	3488
Portage	Ptg	5654
Power	Pr	3697
Powerclub	Prc	8276
Prairie	Prr	12371
Prelude	Pd	4323
Premier	Pm	11940
Preston	Ptn	3328
Pride of Genesee	PG	3365
Progress	Prs	6902
Prohibition	Ph	------
Propo	Prp	1970
Prosperity	Ppr	5380
Purcam	Pcm	12294
Purdue No. 1	Prd No. 1	11380
Purkof	Pk	8381
Purplestraw	Pp	1915
Quality	Qi	4170
Quanah	Qn	12145
Quivira	Qv	8886
Quivira Hybrid	QH	13285
Racine	Rcn	13172
Ramona	Ro	8241
Ramona 44	Ro 44	12390
Ramona 50	Ro 50	12390
Ramsey	Rsy	13246
Red Bobs	RB	6255
Redchaff	Rc	4241
RedChief	RCh	12109
Red Clawson	RC	3393
Redcoat	Rct	13170
Red Egyptian	RE	*12345
Red Fife	RF	3329
Redhart	Rh	8898
Redhull	Rhl	11534
Red Indian	RI	8382
RedJacket	RJ	12713
Redman	Rm	*12638
Red May	RM	5336
Red Rock	RRc	5597
Red Russian	RR	4509
Red Wave	RW	3500
Red Wonder	RWn	------
Regal	Rg	7364
Regenerated Defiance.	RD	3703
Regent	Rgn	11869
Reliance	Rl	7370
Reliant	Rln	12144
Relief	Rlf	10082
Renacimiento	Rcm	12002
Renfrew	Rf	8194
Renown	Rn	11635
Requa	Rq	11554
Resaca	Ra	------
Rescue	Rsc	12435
Reward	Rw	8182
Ribeiro	Rb	7014
Ridit	Rdt	6703
Rieti	Rt	*7015
Rio Negro	RN	12469
Rival	Rv	11708
Rochester	Rsr	5693
Rodco	Rdc	13560
Rosetta	Rtt	13363
Royal	Ryl	12558
Ruddy	Rd	6465
Rupert	Rp	5920
Rural New Yorker No. 6.	RNY 6	5921
Rural New Yorker No. 57.	RNY 57	3516
Rushmore	Rmr	12273
Russell	Rsl	12484
Russian	Rsn	5737
Russian Red	RRd	5928
Rust Resistant Triumph.	RRT	------
Rysting	Rst	------
Saline	Sln	12674
Sanford	Sf	12026
Satisfaction	Ss	3586
Saunders	Sd	12567
Sawtana	Stn	13304
Schlanstedt	Sst	4646
Schonacher	Sc	5942
Seabreeze	Sb	12611
Sea Island	SI	6551
Selkirk	Sk	13100
Seneca	Se	12529

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Variety name	*Abbreviation*	*C. I. No.*
Seneca Chief	SC	------
Sentry	St	13102
Seu Seun	SS	------
Sevier	Sve	6247
Shansi	Sns	12612
Shepherd	Sh	6163
Sherman	Sm	4430
Shoshoni	Ssh	13193
Sibley 81	Sl 81	10084
Silvercoin	Sv	6013
Silversheaf	Svr	2496
Sinvalocho	Svl	12096
Sioux	Sx	12142
Sonora	Sn	3036
Sonora 37	Sn 37	11902
South Africa 43	SA 43	13658
Spinkcota	Sct	12375
Spokane Chief	SCh	13252
Squarehead	Shd	6664
Squareheads Master.	SM	4298
Stafford	Sfr	12706
Stanley	Sly	11391
Steinwedel	Sw	4735
Stewart	Sr	12066
Sturgeon	Sg	11703
Superhard	Spr	8054
Superking	Spk	------
Super Triumph	ST	13669
Supreme	Spe	8026
Supremo	Spo	12531
Surpresa	Sps	12474
Surprise	Sp	2986
Svenno	Svn	13642
Talbot	Tbt	13781
Talimka	Tl	5016
Tascosa	Tcs	13023
Tayland	Tln	12761
Taylor	Tlr	12461
Taylor 49	Tlr 49	13249
Tendoy	Td	13426
Tenmarq	Tm	6936
Thatcher	Tc	10003
Thorne	Tn	11856
Timstein	Tst	12347
Titanic	Tt	------
Touse	Ts	6017
Towner	Tnr	13247
Transfer	Tf	13483
Travis	Tvs	13147
Triplet	Tlt	5408
Triumph	Tmp	12132
Trumbull	Tb	5657
Turkey	Tk	1558
Ukrainka	Uk	8859
Union	Un	11704
Utah Kanred	UK	11608
Vahart	Vh	12537
Valley	Vl	5923
Valprize	Vp	11539
Velvet Don	VD	2122
Vermillion	Vm	13080
Vernal (emmer)	Vn	3686
Vernum	Vnm	12255
Vesta	Vt	11712
Virginia	Vg	------
Waban	Wbn	12992
Wabash	Wbs	11384
Wakeland	Wln	13382
Walker	Wr	6445
Wanken	Wk	13659
Wardal	Wd	13372
Warrior	Wrr	13190
Wasatch	Wsc	11925
Webster	Wst	3780
Wellman	Wmn	------
Wells	Wls	13333
Westar	Wtr	12110
Westmont	Wmt	12930
Wheedling	Wl	4816
White Federation	WFr	4981
White Federation 38.	WFr 38	11906
White Federation 54.	WFr 54	13361
White Fife	WF	*7562
Whiteman	Wm	------
White Odessa	WO	4655
White Polish (*Triticum polonicum*).	WP	3007
White Winter	WW	5219
White Wonder	WWn	6450
Wichita	Wi	11952
Wilbur	Wb	6797
Wilhelmina	Wh	11389
Willet	Wlt	13099
Winalta	Wn	13670
Windsor	Ws	5915
Wisconsin Pedigree No. 2.	WP 2	6683
Yaqui 54	Yq 54	13218
Yorkwin	Yw	11855

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