PRINCIPLES OF CULTIVAR DEVELOPMENT

VOLUME 1

Theory and Technique

Walter R. Fehr

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with the assistance of
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To my wife Elinor, whose numerous contributions to this book and to my life have been of immeasurable value.

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Preface

The development of superior cultivars of plant species is a challenge that tests the ingenuity, patience, and persistence of an individual. Ingenuity is based on an appreciation of the scientific principles of genetics, agronomy, horticulture, statistics, physiology, and many other disciplines that are an essential part of plant breeding. It involves the ability to evaluate an array of alternative methods for cultivar development, assess the resources that are available, and develop a strategy that is efficient and effective. Patience is required to undertake the development of a cultivar, a process that commonly requires 10 years or more. Persistence is essential in dealing with the numerous obstacles that must be confronted, particularly uncontrollable fluctuations in the weather.

As a university professor, it has been my privilege to teach young women and men who have the ingenuity, patience, and persistence required to be a plant breeder. One of my responsibilities has been to help students understand how cultivar development actually is carried out, sometimes referred to as the nuts and bolts of plant breeding. My colleagues generously shared their experiences with me, which made it possible to develop a set of class notes for distribution to the students. Those class notes became the foundation for this book.

The purpose of the book is to provide some assistance in the decision-making process that every plant breeder encounters. There are not any plant breeding programs that are identical in all respects. Each breeder is faced with unique circumstances for which an appropriate strategy of cultivar development must be developed. The plant species, resources available, expectations of the employer, and demands of the marketplace are a few of the factors that contribute to the circumstances that are encountered. To develop an effective strategy of cultivar development, the breeder must be able to understand the alternative methods that could be used and evaluate the genetic improvement that could be realized from each method. This book is intended to describe in detail the alternative breeding methods and to provide guidelines for the evaluation of their advantages and disadvantages under different circumstances.

The selection and application of plant breeding methods for the genetic improvement of a crop species depends on such factors as the types of cultivars that are grown commercially, the type of parental germplasm available, and the objectives of cultivar improvement. To help students and other interested people understand how plant breeders develop an appropriate strategy of genetic improvement, Volume 2 of *Principles of Cultivar Development* was prepared. In that volume, successful plant breeders describe the step-by-step process of cultivar development for the crop series with which they work, discuss alternative procedures that are available for each step of the process, and provide examples of those methods that have been used most successfully.

There is considerable emphasis in current plant research on the role of cellular and molecular biology in genetic improvement of plant species. The results of the research undoubtedly will improve procedures for cultivar development in the future. The emphasis in this book has been placed on techniques that actually have been used to develop cultivars, however, instead of on future possibilities that have yet to be widely adopted by plant breeders. Future opportunities for the improvement of plant breeding methods are addressed by the authors of individual crop species in Volume 2 of *Principles of Cultivar Development*.

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WALTER R. FEHR

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The National Plant Germplasm System

Plant germplasm is the base for productive agriculture. It is the genetic raw material required by breeders for the development of new, superior crop varieties that can ensure a stable, plentiful supply of food, feed and fiber having desirable qualities. Acquisition, preservation, evaluation, and distribution activities of U.S. germplasm resources are coordinated by the National Plant Germplasm System (NPGS).

The NPGS is designed to provide, on a continuing, long-term basis, the plant genetic diversity needed by farmers and public and private plant scientists to improve productivity of crops and minimize the vulnerability of those crops to biological and environmental stresses. Genetic vulnerability of crops comes into play when an out-of-the-ordinary range of stresses from diseases, insects, drought, or temperature extremes exceeds the crop's range of tolerance or resistance to such factors. The results can vary from noticeable yield reduction in localized areas to disastrous crop failures over very large areas.

Protection from crop losses through control of biological and environmental stresses is far more difficult and costly than through increased genetic diversity among varieties of a given crop. Therefore, a NPGS objective is to broaden the genetic diversity of a crop throughout its production area by having that production come from an array of varieties, all productive but each different from the others in its range of tolerance to one or more potential stresses. This variety and range can reduce the likelihood of epidemic losses.

The NPGS now maintains over 400,000 accessions of germplasm in the form of seed and vegetatively propagated stocks. These accessions are primarily landraces and unimproved germplasm from foreign sources. A few working collections and the National Seed Storage Laboratory (NSSL) also maintain some domestic breeding lines and cultivars. Any of this wide array of genetic diversity is available without charge to any *bona fide* plant scientist in the United States. In addition, material in the NPGS is exchanged

with countries around the world for germplasm needed by U.S. scientists. In providing germplasm to users, domestic or foreign, only a portion of a given accession leaves the system. A given accession is never exhausted—it is maintained and increased as necessary.

New accessions of germplasm are added to the system at the rate of 7000 to 15,000 per year. Approximately 70 to 80 percent of these come through exchange with other countries; the rest are acquired directly through foreign and domestic collecting expeditions, and from the user community.

Management of the diffuse system is largely delegated through USDA with the primary coordinating function residing with the Assistant to the Deputy Administrator for Germplasm within the Agricultural Research Service (ARS). The NPGS is also a major component of an international plant germplasm network and, as such, coordinates its efforts with the International Board for Plant Genetic Resources (IBPGR).

The major activities of the NPGS are acquisition, maintenance, evaluation, and enhancement of plant germplasm; research on conservation of genetic diversity; monitoring genetic vulnerability; and information management. These activities are carried out at various locations in the U.S. and its territories. In addition to the thousands of individual federal, state, and private scientists who do research involving breeding, evaluation, and improvement of germplasm, there are four major structural components that make up the NPGS. These are (1) plant introduction facilities and activities; (2) collections—maintenance and evaluation facilities and activities for the long-term base collection at the National Seed Storage Laboratory and the various working collections that exist in federal, state, and private organizations; (3) an information system used for management and operation as well as enhanced communication to scientists regarding the location and characteristics of germplasm they may wish to obtain for research purposes; and (4) various advisory groups which represent the federal, state, and private organizations in the NPGS and advise on germplasm issues as well as specific crop issues and technology.

As an introduction to the National Plant Germplasm System, these structural components and several of their individual units or organizations are described in this overview.

Plant Introduction

The Plant Introduction Office (PIO) is part of the *Plant Genetics and Germplasm Institute* (PGGI) of USDA/ARS at Beltsville, Maryland. This office is the focal point for the acquisition and exchange of plant germplasm. It catalogs all incoming accessions, assigns plant inventory (P.I.) numbers, and distributes P.I. material to maintenance centers or curators according to established protocols and priorities. No collections are maintained by this office.

The Plant Taxonomy Laboratory (PTL), PGGI, identifies material entering the NPGS and provides correct scientific nomenclature. It also plans, expedites, and participates in plant exploration.

The Economic Botany Laboratory (EBL), PGGI, undertakes studies to determine the geographical and ecological distribution of significant diversity in crop species.

The Plant Introduction Station at Glenn Dale, Maryland, is also part of the PGGI. This station distributes pest-free material of prohibited and post entry quarantine categories

of fruits, woody ornamentals, and certain vegetables. It also serves as the Plant Quarantine Facility of the USDA Animal and Plant Health Inspection Service (APHIS).

The Plant Introduction Station at Miami, Florida, is an integral part of the Subtropical Horticultural Research Station of USDA/ARS. This station maintains, evaluates, and releases new varieties of mango, jujube, avocado, and other tropical and subtropical fruits and provides disease-free maintenance of coffee and cacao.

The four state/federal *Regional Plant Introduction Stations* (RPISs) at *Geneva, New York* (NE-9), *Experiment, Georgia* (S-9), *Ames, Iowa* (NC-7), and *Pullman, Washington* (W-6), each have priority responsibility for maintaining primarily "wild type" and introduced germplasm of many selected crops. The crop responsibility lists may include not only crops maintained at the RPIS but also those under other curators at outlying locations in the region. Should any of the outlying collections come under any jeopardy, it is the responsibility of the Regional Coordinator at the RPIS to take steps that will assure their continued safe maintenance. The Coordinators (all are federal) have a national responsibility for each species assigned to them. Some of the major crop responsibilities of each station are as follows:

- *Northeastern Regional Plant Introduction Station, Geneva, New York:* Perennial clover, onion, pea, broccoli, and timothy.
- *Southern Regional Plant Introduction Station, Experiment, Georgia:* Cantaloupe, cowpea, millet, peanut, sorghum, and pepper.
- *North Central Regional Plant Introduction Station, Ames, Iowa:* Alfalfa, corn, sweet clover, beets, tomato, and cucumber.
- *Western Regional Plant Introduction Station, Pullman, Washington:* Bean, cabbage, fescue, wheat, grasses, lentils, lettuce, safflower, and chickpeas.
- *State/Federal Interregional Potato Introduction Station (IR-1), Sturgeon Bay, Wisconsin:* Focuses on potato variety development with strong emphasis on germplasm maintenance and upgrading to meet breeders' needs. It also supports research on methods for effective maintenance of potato germplasm in the form of clonal material, either through tuber regeneration or meristem preservation.

Collections

The National Seed Storage Laboratory (NSSL) at Fort Collins, Colorado, is a USDA/ARS facility and the nation's only long-term seed storage facility. It has been in operation since 1958. The Laboratory maintains plant germplasm as a *base collection* for the United States and is a backup base collection for many crops in support of the global network of genetic resources centers. Present categories of stocks in storage include basic plant introductions, recently released and obsolete varieties, open-pollinated parental lines, genetic stocks, differential host and virus indicator stocks, and type specimens of varieties registered under the Plant Variety Protection Act for future reference.

The NSSL base collection is not intended to meet the day-to-day needs of plant breeders and other plant scientists, but rather serves as a reserve stock to prevent loss of germplasm and erosion of genetic diversity. Generally, seed samples in the base collection are also held in a working collection outside the NSSL and therefore are distributed from the NSSL only when unavailable from another source.

Base collection samples are for indefinite storage with regrowing as infrequently as

possible so that genetic changes through repeated seed increases do not occur. However, the seed is regrown often enough to prevent loss of viability. The working collections are analogous to checking accounts—there to be drawn upon as needed, but not overdrawn. The base collection is analogous to a savings account—to be used only when the checking account runs out.

The NSSL's research is concentrated on determining optimum storage conditions for each group of species with similar storage requirements. Seed viability is monitored on a regular schedule. The Laboratory has a current inventory of over 200,000 accessions.

The primary objective of the *National Clonal Repositories* is to maintain and preserve valuable fruit, nut, and other selected crops which are normally propagated by vegetative means and to make such germplasm readily available to plant breeders and other plantsmen. Secondary objectives of the repositories are to collect, worldwide, accessions of valuable germplasm; to evaluate such accessions; and to conduct and encourage appropriate research related to improved methods of evaluation, propagation, preservation, storage, and distribution of clonal germplasm. Twelve separate clonal repositories are planned. Five are now in operation:

- *Corvallis, Oregon:* Pears, filberts, hazelnuts, small fruits, hops, and mint.
- *Davis, California:* Grapes, stone fruits, and nuts.
- *Miami, Florida:* Some subtropical and tropical fruits and sugarcane.
- *Indio, California:* Date palm.
- *Mayaguez Institute of Tropical Agriculture (MITA), Mayaguez, Puerto Rico:* Tropical fruits and industrial crops.

The USDA Small Grains Collection is located in the *Plant Genetics and Germplasm Institute* (PGGI) at Beltsville, Maryland. This working collection contains some 90,000 wheat, barley, oats, rice, rye and *Aegilops* accessions. Annually, over 100,000 samples of these accessions are distributed in response to requests from all parts of the world.

Working collections are an assemblage of germplasm (genetic resources) maintained to meet the day-to-day research needs of breeders, geneticists, pathologists, entomologists, cytologists, agronomists, horticulturists, and other users who wish to utilize it for research purposes. The curators of working collections provide the primary interface with the user community. Requests for seed are channeled through the curators and seed from domestic sources enters the system through the working collections. Working collections include foreign acquisition, wild relatives of crop species, acquisitions from the domestic flora and domestic cultivars, plus some advanced lines recommended by the NPGS Crop Advisory Committees (see p. 475). It is a goal of NPGS that all accessions in working collections also be catalogued and maintained in the National Seed Storage Laboratory.

A *curator* is an individual who has accepted specific responsibility to physically maintain, protect, control access to, and distribute specific plant germplasm. An individual curator may be the coordinator of a RPIS or someone independent of the RPISs but in an identifiable curatorial position.

The curators of these working and base collections agree to maintain the collections under good storage conditions and by seed rejuvenation as required, or by protected, well-managed plant repositories in the case of clonally propagated species. Curators maintain a current inventory of accessions in the collection and agree to make reasonable amounts of the germplasm under their care available at no charge to *bona fide* research scientists and institutions. The curator does not have the option of discarding elements

of the collection on his own volition. When changes in program, personnel, physical facilities, or administrative policy place a collection in jeopardy, it is the curator's responsibility to notify appropriate officials within the NPGS.

Another important portion of the NPGS, which falls in the germplasm collection category, pertains to the *genetic and mutant stock centers*. These are working collections of individual accessions genetically defined by a specific genetic or chromosomal trait controlled by a gene at an allele, locus, chromosome, translocation, inversion, and so on. The genetic stock centers are an essential underpinning of the research effort, both basic and applied, on plants in the United States and throughout the world. These stocks have been utilized for research and education in plant breeding, genetics, physiology, biochemistry, and molecular genetics. More specifically, advances in knowledge made possible by, or at least facilitated by, the existence of these stock centers, have been in the areas of: gene function and process of mutation; fine structure of genetic material; behavior and mechanisms of chromosomes; processes of starch biosynthesis; biosynthesis of storage proteins and carotenoids; and existence and properties of migrating genetic materials and mutable loci. These genetic and mutant stocks often require specialized maintenance procedures.

Examples of notable genetic stock collections are

Barley: Over 3000 genetic stocks, maintained by and distributed from the Department of Agronomy, Colorado State University, Fort Collins.

Cotton: About 300 genetic stocks, maintained by and distributed from the Agronomy Field Laboratory, Texas A&M University, College Station.

Oats: Over 200 genetic stocks, maintained by and distributed from the Small Grains Collection, ARS, Beltsville, Maryland.

Peas: 5000 single mutants, genetic stocks, multimarker lines, linked genes, maintained by and distributed from the Department of Seed and Vegetable Sciences, New York State Agricultural Experiment Station, Geneva.

Corn: About 51,000 different genotypes, in addition to translocations and other chromosome or cytological stocks, are maintained and distributed from the Maize Genetics Cooperation Stock Center, Department of Agronomy, University of Illinois, Urbana.

Tomatoes: 1700 genetic and chromosomal stocks of *Lycopersicon esculentum* and related species, maintained by and distributed from the Department of Vegetable Crops, University of California.

Wheat: 600 genetic stocks, maintained by and distributed from ARS scientists at the University of Missouri, Columbia.

Information System

A feasibility study was conducted during 1976–77 which investigated and identified the need for information management systems in the efficient collection, conservation, distribution, and utilization of plant germplasm in the National Plant Germplasm System.

The USDA Science and Education/Agricultural Research Service recognized the critical need for a nationally unified information system to serve the diverse needs of the NPGS. A cooperative agreement with the Laboratory for Information Science in Agri-

culture (LISA) to develop a computer-based information system led to formation of the Germplasm Resources Information Project (GRIP).

Analysis of the diverse needs of the NPGS community, its abundant information resources, and the necessary management and use of those resources led to identification of two basic groups of information users within the NPGS—those who supply and those who demand information. "Suppliers" are those who *acquire, maintain,* and *distribute* germplasm and data such as curators, and staff of the NSSL and various plant introduction stations. The "demand" group is composed of those who *use* germplasm and data such as plant breeders, scientists, and researchers. The needs of both groups were identified and small-scale operational prototypes of the system were developed and installed at such NPGS sites as the Regional Plant Introduction Stations. Testing and evaluation of these prototypes (including consideration of user responses and suggestions) then led to the information system's user-oriented design. Among the ways the information system will serve the supply side will be by providing mechanisms or tools to register accessions as they enter the NPGS, maintain seed inventories, monitor viability of collections, process seed orders, exchange information with other "suppliers," and generate summary reports. The system will allow the demand side to receive information on accessions (including characteristic data and use, and location in the system) as well as requested samples on a timely basis.

The now completed design phase and start of a four-phased implementation will bring the transformation of GRIP to GRIN—the Germplasm Resources Information Network—and continued growth of information management and use in the NPGS.

The Information Network will include not only computer hardware and software, but also people performing specialized tasks, work procedures, and administrative and policy functions. GRIN has been designed to accommodate growth of the NPGS and changing needs brought about by that growth—including additional information system features and more NPGS facilities and users. This flexibility in fulfilling many critical needs is the key to GRIN's anticipated success and continued evolution.

Advisory Groups

The National Plant Genetic Resources Board (NPGRB) provides policy advice directly to the Secretary of Agriculture. The task of the Board is to advise the Secretary on problems, needs, and welfare of the nation's plant genetic resources activities as these impact the food production system.

The duties of the National Plant Genetic Resources Board are: (1) to inform themselves of domestic and international activities to minimize genetic vulnerability of crops; (2) to formulate recommended actions and policies on collection, maintenance, and utilization of plant genetic resources; (3) to recommend actions to coordinate the plant genetic resources plans of several domestic and international organizations; (4) to recommend policies to strengthen plant quarantine and pest monitoring activities; and (5) to advise on new and innovative approaches to plant improvement.

The Board meets at least twice each year. Members of the Board are appointed by the Secretary.

The National Plant Germplasm Committee (NPGC). This Committee was established on May 20, 1974, when the Agricultural Research Service (ARS) agreed to a restructuring of the National Coordinating Committee for New Crops, which had been created in 1949

by State Agricultural Experiment Station (SAES) directors. The functions of the NPGC are

- Provide coordination for the research and service efforts of federal, state, and industry units engaged in the introduction, preservation, evaluation, and distribution of plant germplasm, through representation of all units' views by Committee members.
- Develop policies for the conduct of the national plant germplasm program and for its relationships to international plant germplasm programs.
- Develop research and service proposals and justification for adequate funding of regional and national plant germplasm activities.
- Actively advocate mutually agreed upon proposals with SAES associations and USDA agencies.
- The NPGC forum will also be the principal way in which SAES interests can be presented and harmonized with federal interests at a technically informed level.

The NPGC is chartered to meet at least once each year.

Each of the four regions (NE-9, NC-7, S-9, W-6) has a *Regional Technical Committee* composed of a representative from each State Agricultural Experiment Station in the region as well as representatives from Agricultural Research Service and Soil Conservation Service and, in some cases, Forest Service and Bureau of Land Management (Department of Interior). Each regional technical committee has an Administrative Advisor who is a State Agricultural Experiment Station director. The committees provide technical advice to the Regional Plant Introduction Stations and make policy recommendations to the National Plant Germplasm Committee. Each committee is represented on the NPGC by its respective Administrative Advisor.

The *Crop Advisory Committees* represent the germplasm user community and provide guidance and coordination to the NPGS. There are currently 13 committees—one each for alfalfa, barley, beans, corn, cotton, oats, peanuts, peas, potatoes, sorghum, soybeans, tomatoes, and wheat. The crop advisory committees are composed of plant scientists drawn from the public sector, both the federal and state, as well as from the private sector. The curator of each crop serves as a member on his specific crop's committee. The crop advisory committee provides both general and specific guidelines, policy and work programs, for work and activities in the germplasm management of a specific crop.

The crop advisory committees have worked on problems regarding exchange of information and have developed minimum lists of descriptors to characterize each crop. They have also developed germplasm evaluation plans. Other pertinent issues addressed by the committees are

- Germplasm acquisition strategies.
- Working collection storage conditions.
- Long-term storage conditions.
- Regeneration.
- Seed distribution guidelines.
- Standards for germplasm evaluation.

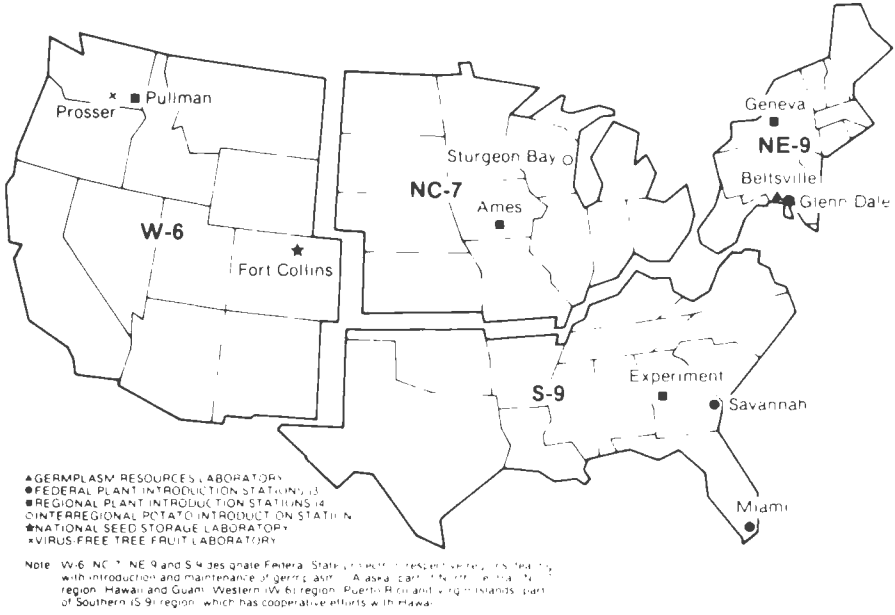
The ARS Plant Germplasm Coordinating Committee coordinates day-to-day operational matters; advises the Administrator of ARS of problems, needs, and opportunities; and recommends priorities for ARS-funded explorations.

The International Board for Plant Genetic Resources (IBPGR) is an autonomous,

international, scientific organization under the aegis of the *Consultative Group on International Agricultural Research* (CGIAR). The IBPGR, which was established by the CGIAR in 1974, is composed of 15 members from 13 countries; its Executive Secretariat is provided by the Food and Agriculture Organization (FAO) of the United Nations, Rome.

The basic function of the IBPGR, as defined by the CGIAR Group, is to promote an international network of genetic resources centers to further the collection, conservation, documentation, evaluation, and use of germplasm and thereby contribute to raising the standard of living and welfare of people throughout the world. The CGIAR Group mobilizes financial support from its members to meet the budgetary requirements of the International Board.

The International Board's network includes regional, national, and international institutions working to preserve the world's dwindling genetic resources. Among these institutions are International Agricultural Research Centers of the CGIAR and other institutions which have agreed to IBPGR designation as those responsible for maintaining major base (i.e., long-term storage) seed collections of the world-wide principal food crops. There are a limited number of designated base collections, because their operation requires extensive facilities and labor. For this reason several base collections are in developed countries. However, material in these collections is freely available and it is the International Board's policy to encourage and assist the establishment of genebanks in centers of genetic diversity (which are almost exclusively developing countries). These locations provide advantages to genebanks in terms of multiplication, evaluation, regeneration, and regional quarantine restrictions.



Note: W-6, NC-7, NE-9 and S-9 designate Federal-State [illegible] with introduction and maintenance of germplasm. Alaska part of Northern (N-9) region, Hawaii and Guam Western (W-6) region, Puerto Rico and Virgin Islands part of Southern (S-9) region, which has cooperative efforts with Hawaii.

Major stations of the National Plant Germplasm System.

APPENDIX B

A Statement of Responsibilities and Policies Relating to Development, Release, and Multiplication of Publicly Developed Varieties of Seed-Propagated Crops

A policy statement of the Experiment Station Committee on Organization and Policy of the Experiment Station Section of the Association of State Universities and Land Grant Colleges, and the Agricultural Research Service and the Soil Conservation Service of the United States Department of Agriculture.

June 26, 1972

Foreword

This policy statement pertaining to development, release, and multiplication of varieties is intended for guidance of the State Agricultural Experiment Stations and the United States Department of Agriculture. In this policy statement the term *variety* (synonymous with the term *cultivar*) is used in accordance with the International Code of Nomenclature of Cultivated Plants, 1969.

The correctness of use of the terms "cultivar" and "variety" in the English language is frequently not clearly understood. The International Code of Nomenclature of Cultivated

Plants has adopted the term "cultivar" as an international term which is proper for use in any language. In the English language, the term "variety" may be used as an exact equivalent or as a synonym of "cultivar." Care should be taken not to confuse the term with the English translation of *varietas*, also *variety*, which is a botanical classification. To insure differentiation between "variety" when used for a cultivated variety and "variety" when used as a botanical classification, the abbreviation of the former is cv., whereas the abbreviation for the latter is var.

In the English language version of editions of the Code prior to 1969, the term "variety" was included in parentheses throughout the Code following each use of the term "cultivar." This medium was decided upon so that no one could possibly question the complete equivalence of the terms "cultivar" and "variety" when referring to cultivated varieties. The redundancy of repeating both terms was eliminated in the 1969 edition by the International Commission for the Nomenclature of Cultivated Plants. Instead, the following explanations were included:

> The term cultivar is equivalent to variety in English, *variete* in French, *variedad* in Spanish, . . . whenever these words are used to denote a cultivated variety.

Article 10, Note 4:

> The terms cultivar and variety (in the sense of cultivated variety) are exact equivalents. In translations or adaptations of the Code for special purposes, either *cultivar* or *variety* (or its equivalent in other languages) may be used in the text.

Clearly, the 1969 edition in no way represents a change in policy relative to use of the English term "variety." In fact, if the Code were to be reproduced for popular use in the English language, the International Commission would sanction use of only the term "variety" throughout the entire Code. There certainly is no regimentation in the Code for universal use of the term "cultivar" when referring to cultivated varieties.

It would seem that good judgment should prevail in the use of the equivalent terms. In scientific papers which have international consumption, the international term "cultivar" may be most clearly understood. In papers or documents intended for use by the English-speaking lay public or nonscientific community, the term "variety" may often be considered the more desirable synonym.

The term "variety" means a subdivision of a kind which is distinct, uniform, and stable: "distinct" in the sense that the variety can be differentiated by one or more identifiable morphological, physiological, or other characteristics from all other varieties of public knowledge; "uniform" in the sense that variations in essential and distinctive characteristics are describable; and "stable" in the sense that the variety will remain unchanged to a reasonable degree of reliability in its essential and distinctive characteristics and its uniformity when reproduced or reconstituted as required by the different categories of varieties. The definition of a variety is understood to include the following categories: clonal varieties, line varieties (inbreds), open-pollinated varieties of cross-fertilizing crops, synthetic varieties, hybrid varieties (F_1), and F_2 varieties.

This policy statement has been developed with full cognizance of the contents and implications of the Variety Protection Act, Public Law 91-577. Mutually helpful working relationships among the State Agricultural Experiment Stations, the United States Department of Agriculture, and private plant breeders and seed companies should be encouraged to enhance the effectiveness of both public and private plant breeding efforts.

This revision of the policy statement (dated June 26, 1972) supersedes all previous

documents. It has been approved in the four State Agricultural Experiment Station Director's Associations, The Experiment Station Committee on Organization and Policy (ESCOP), and the Agricultural Research Service and the Soil Conservation Service of the USDA.

This statement outlines general policies and procedures and points up general functions and opportunities for improving both public and private activities and services in the development and use of improved seeds and other propagation materials of publicly developed varieties. It covers seed-propagated varieties of both field and horticultural crops. Adaptations to specific crops will be required.

State Agricultural Experiment Stations (SAES) and the U.S. Department of Agriculture (USDA) were established to serve farmers, industries related to agriculture, and through these, all the people. SAES and USDA have functions and responsibilities at local, state, regional, and national levels. Both are supported largely by public funds. The public interest and good judgment require that they work together and reduce duplication to the desired minimum. Close cooperation in developing policies for making results of individual and joint effort available to the public is an obligation. This includes policies concerned with developing and distributing improved crop varieties from state and federal plant breeding operations, and also working with and assisting private enterprise to serve the public effectively.

A statement of important points of policy in developing improved varieties and releasing these to seed producers and seed users follows:

1. Sources for New Germplasm[1] Improvement

(a) *Collection, introduction, and preliminary evaluations of new plant germplasm*

The USDA, through its Agricultural Research Service, in cooperation with the State Stations and the SCS National Plant Materials Center, collects, distributes, and preserves plant germplasm from foreign and domestic sources. Through various cooperative arrangements, plant characteristics are determined and catalogued. These include reactions to insects, diseases, and climatic variations and determination of quality, potential promising end-products, and other desirable traits. This information is made available to public and private agencies.

State and other federal agencies also conduct domestic and foreign plant explorations. Such activities should be coordinated with those of the Agricultural Research Service in order to eliminate possible duplication in germplasm originally introduced and its subsequent evaluation and distribution. Provision to make resulting plant collections available to public and private plant breeders is encouraged.

Breeding lines and nonreleased varieties received from cooperating scientists, domestic and foreign, should be handled in a manner that will not violate the terms or conditions under which they are obtained.

(b) *Use of introductions*

As a further source of information on the characteristics of introductions, reports on observation and performance tests are requested from those receiving the materials. These reports are compiled, annotated, and disseminated through the four regional research (RRF) projects on new crops.[2] Lists of stocks preserved in the National Seed Storage Laboratory, Fort Collins, Colorado, are prepared and distributed. Individuals or organizations proposing

[1]Germplasm is defined as the material basis of heredity. The one-word format has been adopted. (*Dictionary of Genetics*, R. L. Knight, Chronica Botanica Company, Waltham, Massachusetts. 1948.)

[2]Reference: The National Program for Conservation of Crop Germplasm. *A Progress Report on the Introduction, Screening and Preservation of Plant Material, June 1971*. University of Georgia, Athens, Georgia.

to increase and distribute seed or plant materials of such introductions in their original genetic form are asked to make this intention known to the agency from which the material came. Plans for joint release, thereby, can be considered. Confusion that might arise from duplication of identifying names or numbers given to the same introduction by public or private interests can thus be avoided (see section 5).

(c) *Recognition of originating source of introduced materials*

The source of introduced plant materials should be publicly acknowledged. Original Plant Introduction (PI) number or other identifications should be cited.

When the genetic make-up of the introduced material is modified by selection, inbreeding, or hybridization, and the value of the line has been demonstrated as a new variety, as a breeding line, or as the source of a specific genetic character, the agency providing the original material should be informed of the specific characters in the new variety or line derived from the original introduction. The original source of these breeding materials should be acknowledged publicly, again referring to the PI number, or to an identifying accession number when no PI number has been assigned.

2. Studies of Heredity and Methods of Improvement

(a) *Obligation of State Agricultural Experiment Stations and U.S. Department of Agriculture*

The SAES and USDA are obligated to conduct studies of the characters and properties of plant materials, modes of reproduction, the inheritance of characters, and the possibilities of modification and control of heredity.

(b) *Prompt availability of results*

These agencies and their workers are further obligated to make the results of these studies available to all plant breeders, public or private, through prompt publication of research findings.

(c) *Availability and use of basic genetic materials*

Basic genetic materials should generally be released to all plant breeders who request them. The term *basic genetic material* refers to plant material possessing one or more potentially desirable characters which, in the opinion of the Experiment Station Directors and/or agency Administrators, may be of value in plant breeding and when, in their opinion, such general release is in the best interests of United States agriculture and the state or agency research program.

Periodically, the originating station and/or agency should notify the public of germplasm releases, specifying limitations on use and on the amount of material available for distribution.

Every effort should be made to insure that basic genetic materials are not monopolized by any interests. Furthermore, inbreds, experimental lines, and basic genetic materials should not be released in foreign countries prior to their release in the U.S., unless it is agreed that there is little prospect of the material being of value in this country.

(d) *Acknowledgment of use of publicly or privately developed basic genetic materials*

Public acknowledgment of the use of publicly or privately developed basic genetic materials in the development of a new variety is an obligation of the recipient agency, industry group, or individual, as it gives due recognition to the contribution by public or private programs.

3. Breeding to Develop Superior Varieties

(a) *A function of the Stations and the U.S. Department of Agriculture*

The breeding of better varieties to reduce production hazards, to improve quality, and to increase biological efficiency is one of the important functions of the State Stations and the Department. As problems arise which can be solved by plant breeding, it is obvious that these governmental agencies have an obligation to investigate them.

(b) *Interrelations with private plant breeding programs*

Free interchange of a wide range of materials, specialized facilities, scientific competence in many disciplines, and the opportunity to test, observe, and study reactions under a wide range of environmental conditions enhance the probability of success.

(c) *Acknowledgment of use of publicly and privately released germplasm*

Public acknowledgment of the use of publicly and privately released germplasm in a closed-pedigree variety is an obligation of the recipient agency, industry group, or individual, as it gives due recognition to the contribution by public or private programs.

4. Testing and Evaluating Experimental Varieties

(a) *Adequate comparisons with standard varieties*

Experimental varieties and lines should be tested for yield, quality, survival, disease and insect reaction, and other important characteristics in comparison with standard varieties, using techniques that assure valid measures of performance.

(b) *Interstate and regional tests*

Some varieties are not limited in adaptation by local, state, regional, or national boundaries. Interstate testing and interchange of materials should be encouraged. When appropriate, international testing should also be encouraged. Regional testing facilitates more general use of widely adapted varieties. It also reduces time needed to provide reliable information on varietal adaptations.

(c) *Testing for special requirements*

New varieties of crops to be used for food should be tested for those components of nutritive composition or concentration of toxic constituents in which they reasonably might be expected to vary significantly from varieties in commercial production. The term "vary significantly" has been tentatively defined as varying 10 percent in toxicological content and 20 percent in nutritive content. The Food and Drug Administration, HEW, requires submission of data for proposed new food varieties that have had significant alteration of such composition. Submitted data will permit determination as to whether the variety merits listing as "Generally Regarded as Safe" (GRAS). (Federal Register, Document 71-8976, page 12094, June 18, 1971.)

New varieties of crops to be used for specialized industrial or other purposes should be tested for these uses to insure that they are satisfactory. The trade, industry, and specialists using the crop should have opportunity to evaluate a variety before it is released.

(d) *Protecting lines and varieties against premature or unauthorized distribution*

All reasonable precautions should be taken to protect the privileged or restricted status of propagating materials, experimental lines, or experimental varieties during testing and seed increase to prevent pirating and premature or unauthorized distribution prior to release. The possibility that an application for variety protection may be filed intensifies the need for such precaution.

5. Decisions on Release of Varieties

(a) *Policy committee or board of review for variety release*

Decisions on the release of new varieties should be made for each state by the appropriate agricultural agency of that state. It is recommended that in each state there be a policy committee or board of review charged with the responsibility of reviewing the proposal for the release of a new variety. Appropriate information concerning characteristics, performance, area of adaptation, specific use values, seed stocks, and proposed methods of varietal maintenance and increase and distribution should be presented to this committee as a basis for its decision.

(b) *Interstate release procedures*

When a variety has been tested on an interstate basis, opportunity to consider simultaneous release should be given each state in the interstate program.

If, for some reason, prior interstate testing was neglected or impossible, the state which may shortly release a new variety should offer to all interested states seed of the new variety for testing and increase. Nearby states may thus obtain information to answer questions from potential users about the new variety. Regional advisory committees may set guidelines for sharing of foundation seed stocks among states.

When the development of a new variety is the result of cooperative effort by a state or states and a federal agency, consideration for release should be a joint responsibility of the agencies involved. Appropriate use should be made of the services of National Variety Review Boards of the Association of Official Seed Certifying Agencies and the U.S. Plant Variety Protection Office in determining novelty of and in cataloging new varieties.

6. Standards for Release of Varieties

A variety should not be released unless it is distinctly superior to existing varieties in one or more characteristics important for the crop, or it is superior in overall performance in areas where adapted, and is at least satisfactory in other major requirements. A single major production hazard which a new variety can overcome, e.g., a highly destructive disease, may become the overriding consideration in releasing a variety. Varieties with a very limited range in adaptation should not be released unless performance in that limited range is outstandingly superior, or the variety possesses important use values not otherwise available, including diversification of the germplasm base for a species.

7. Naming and Registering of Varieties

(a) *Designation*

A new variety should be given a permanent designation before it is released. The designation should be acceptable to the states participating in the release, but the originating station or agency has the final responsibility. Brevity in designation is desirable. When this designation is a name, one short word is preferable; two short words are, however, acceptable. Meaningful number designations or combinations of words, letters, and numbers, consistent with accepted procedures, are also acceptable.

The International Code of Nomenclature for Cultivated Plants provides guides for the naming of varieties. It is recommended that this source be consulted with respect to new variety names.

(b) *Use of names*

Under no circumstances should a variety be distributed under more than one name, nor should the same name be used more than once in a given crop. Similar names should also be avoided. Provisions of the Federal Seed Act (53 Stat. 1275) apply.

Once established, a legitimate varietal name should not be changed. Names which are misleading or which are identical or similar to brand names or trademarks associated with agricultural products should be avoided, as there may be an implied association of the variety and trade names or trademarks. Proposed names should be cleared for possible infringement of trademarks, and previous use of the proposed variety name. This can best be accomplished by contacting the Seed Branch, Grain Division, Agricultural Marketing Service.

(c) *Registering varieties*

Information on new varieties of crops for which national variety review boards have been established should be submitted to the review board following consideration by the state variety committee but before final release is made.

New varieties of crops should be registered. Information for the registration or listing of

varieties should be submitted promptly following registration of the variety with the Crops Science Society of America or the listing of the variety with the American Society for Horticultural Science. Procedures for the registration of varieties are available from CSSA, and procedures for listing of varieties are available from ASHA.

8. Definition of Seed Classes and Certification Standards

The Association of Official Seed Certifying Agencies in its "Certification Handbook," Publication No. 23, dated June 1971, defines the various classes of seed and certification standards. These definitions as they now stand and as they may be amended in the future are hereby made a part of this policy.

9. Increase and Maintenance of Breeder Seed

(a) *Responsibility for maintaining breeder seed*

The originating Station or Agency should prepare a statement of plans and procedures for maintenance of stock seed classes, including limitations on the number of generations through which the variety may be sold by variety name.

When a variety is sufficiently promising to justify consideration for release, breeder seed should be increased to the volume needed to produce and maintain required foundation seed. So long as a variety is retained on the recommended list of the originating state, that state should maintain a reasonable reserve of breeder seed, which will be used to replenish and restore foundation seed of the variety to the desired level of genetic purity. When the variety is distributed in several states, or when the originating state or agency ceases to maintain breeder seed of a variety, a mutually satisfactory plan should be formulated by the interested states or agencies regarding the maintenance of breeder seed. Interested states should be notified well in advance by the originating state or agency when it plans to discontinue maintenance of breeder seed of a variety.

When a variety is to be released jointly by two or more states, a procedure should be formulated for a supply of breeders seed to be made available to each state.

(b) *Supplying sample of seed to National Seed Storage Laboratory*

A sample of breeder or foundation seed of all newly released varieties should be supplied by the originating state or agency to the National Seed Storage Laboratory, Fort Collins, Colorado. Recording forms are provided by that laboratory.

10. Increase, Maintenance, and Distribution of Foundation Seed

(a) *Multiplication of foundation seed*

An adequate and recurring supply of foundation seed is of prime importance in the multiplication of a variety. Reserves of foundation seed should be maintained to assure a continuing supply in the event of a seed crop failure. Foundation seed of publicly produced varieties should be increased under official guidance. It should be produced by those who have the experience, facilities, and skill to assure adequate supplies of seed with acceptable levels of genetic purity.

(b) *Distribution of foundation seed*

Minimal problems arise when there is simultaneous release of foundation seed of a new variety in all interested states. When a variety release is not simultaneous, distribution of foundation seed may present problems among the states. When foundation seed is distributed into another state where the variety is being distributed under allocation as a new release, the foundation seed should be offered through, or with the concurrence of, the official seed stocks or certifying agency in that state.

(c) *Basic principles in foundation seed programs*

Foundation seed should be released in a manner that will be of the greatest benefit to users and the public in general. Foundation seed should not be used for speculative purposes. Within this context, Foundation Seed programs should recognize the following basic principles:

(1) Qualified seed growers and seedsman should have an opportunity to obtain appropriate planting stocks of unrestricted varieties at an equitable cost, recognizing that selective allocations may be necessary to achieve increases to meet the needs of potential users.

(2) Restricted release of breeder and/or foundation seed of a variety is acceptable in situations and to the extent that general release to seed growers and/or seedsmen will not provide adequate seed of the variety on a continuing basis. If a restricted release policy is chosen for release of a variety, state and federal agencies, as well as private breeders (through state seed associations, ASTA, NCCPB) should be appropriately notified and given an opportunity to respond or bid on that particular variety.

(3) Planting stocks of varieties developed cooperatively with the agencies of USDA ordinarily will be made available through or with the concurrence of the seed stocks or certifying agency of the cooperating state(s) at an equitable cost to qualified seed growers and seedsmen. In special circumstances, e.g., No. 2 above, consideration may be given to granting limited term exclusive rights.

For this purpose, consideration should be given to applying for certificates of variety protection under the Plant Variety Protection Act. Where the new variety was developed cooperatively, the certificate will normally be assigned jointly to the USDA and the cooperator. When the cooperator is a public institution, title may be left with the cooperator provided he follows the guidelines set forth in Federal Regulations as to licensing.

11. Preparation and Release of Information

(a) *Coordination of publicity among states and agencies*

Seed producers, distributors, and users should be informed as fully as possible, consistent with variety testing policies and procedures within each state, of the values and the adaptation of new varieties in comparison with other available varieties.

Pertinent information as to the basic facts of origin and characteristics, and data justifying the increase and release of a new variety, shall be prepared by the fostering state(s) and or agency(ies) and provided to other interested states or agencies. The information used in deciding upon release of a new variety should also be used to inform seed producers, distributors, and the public of its value. Participating states or agencies should use this material, supported or modified by their own information, in state or national publicity. Publicity intended for national or regional periodicals should include information on the regional adaptation of the variety. A uniform date for the release of initial publicity should be agreed upon by the fostering states and/or federal agencies.

Appropriate information concerning actions with respect to Plant Variety Protection, including certification requirements, should be included in publicity releases, when appropriate.

The above procedure is intended to provide information that is complete, fair, and unbiased, and will make it possible for seed producers, distributors, and users to make sound judgments in selecting varieties.

(b) *Matching seed production and demand of varieties*

Seed production and demand must be developed together insofar as possible to assure that a variety will make its maximum contribution to agriculture. Thus, promotional publicity in advance of the release of a new variety, or before seed is available, or incomplete publicity following its release is not desirable. An educational program setting forth the superior characteristics, region of adaptation, and any special limitations which have been identified should be coordinated with seed supply.

APPENDIX C

Outline of Procedures for Seed Release of New Crop Varieties, Hybrids, or Genetic Stocks; Iowa Agriculture and Home Economics Experiment Station*

1. The research project leader for the crop involved establishes the merits of the selection through evaluations over a period of years. This usually involves state and regional nursery testing, but the regional aspects of testing may not always be accomplished or necessary, particularly where genetic stocks or inbred parental lines are involved. The guidelines and policies of the North Central Regional Committee (NCS-1) and of the Experiment Station Committee on Organization and Policy (ESCOP) setting forth principles to be followed by SEA-AR, United States Department of Agriculture, and experiment stations relative to development, multiplication, and distribution of publicly developed varieties also should be considered.
   a. The nature and extent of cooperative regional nursery testing with SEA-AR, the Soil Conservation Service, or other USDA agencies varies with individual crops, but standards of evaluation acceptable to the cooperating state and federal agencies for a specific crop should be met.
   b. Superiority for a new selection over varieties or hybrids currently available in at least one significant characteristic, or a complex of characteristics, should be firmly established

*February 1980. Prepared by R. E. Atkins, Agronomy, based on procedure now followed and suggestions of the Crop Breeding and Improvement Research Panel

before a proposal for release is considered. Three years of data are preferred when improved yield is the new character.

c. One year before a new selection is recommended to the departmental committee, a notification of tentative intent to release should be prepared by the project leader and sent to his department head and to his project (crop) counterpart in other states where the new variety may be expected to be produced. An offer to provide limited quantities of seed for testing may be included with the notification. This notification may not be necessary or appropriate for specific genetic stocks or inbred parental lines.

2. The research project leader prepares and presents the performance data and supporting information necessary for making a formal request to the Department's Variety Release Committee. Supporting information should include origin, pedigree, description of varietal characteristics, suggested name(s) or number for the new variety, justification for release, and proposed schedule for foundation seed increase and release of publicity
3. If the proposal to release receives approval by the department evaluation committee, the request and information are submitted to the Department Head for approval and transmittal to the Associate Director of the Iowa Agriculture Experiment Station. Forms to accompany this request are available in the department office.
4. The Associate Director of the Iowa Agriculture Experiment Station appoints an *ad hoc* committee within the experiment station to consider the proposed release, and transmits the release and performance information to them for evaluation.
5. If release of the variety, hybrid, or genetic stock is recommended by the *ad hoc* committee of the Iowa Station and is approved by the Associate Director, the recommendation is transmitted to the Department Head and the notification of release to other states and to federal and commercial agencies continues as follows:
   a. When SEA-AR, SCS, or other USDA agency cooperation is involved directly in the development of the variety, the information and performance data relative to the release are transmitted by the Associate Director (in accordance with SEA-AR Administrative Memorandum 950.1 on preparation of joint release notices) to the Area Director of SEA-AR, and to the SCS or other USDA agency for their recommendation relative to joint release of the variety. Concurrence by the USDA is not mandatory for the originating state to proceed with a release of the variety.
   b. Investigation of prior use of the proposed variety name, possible conflicts with trademark or patent regulations, etc. will be conducted by the USDA personnel as well as by the project leader. In accordance with Article 15 of the International Code of Nomenclature for Cultivated Plants, variety names shall be markedly different from a scientific name of Latin form.
   c. For those crops where a variety review board is established, the project leader should obtain forms from the Chairman of the National Certified Variety Review Board and provide the information and performance data required by that board.
   d. Schedules and arrangements for the production of foundation seed are made cooperatively by the research project leader and the Production Manager, Committee for Agricultural Development, Iowa Agriculture Experiment Station and the increase of foundation seed is initiated.
   e. An offer to share foundation seed with other states is prepared cooperatively by the project leader and the Production Manager C.A.D., approved by the Department Head and Associate Director of the Iowa A.E.S., and sent to the appropriate counterparts in other states. Seed for increase should be offered to other states only one year in advance of the release of foundation seed to Iowa seed growers.

   Foundation seed allotment procedures vary with different crops. The procedure for release for each crop is approved by an Advisory Committee of the Committee for Agricultural Development. Different advisory committees are appointed for each crop. The small grain and soybean committee operates within the framework of an established

release policy approved by the Board of Trustees of the C.A.D. A general offer to share seed may not be appropriate or feasible for specific genetic stocks or inbred parental lines.

f. If protection under the provisions of the Plant Variety Protection Act of 1970 is recommended by the experiment station policy for the type of crop and seed, the research project leader for the crop involved shall obtain the forms and procedural information from the Plant Variety Protection Office that are necessary currently to secure the variety protection. The project leader provides the descriptive information requested, and submits the completed form(s) to the Associate Director of the Iowa A.E.S. for approval and transmittal to the Plant Variety Protection Office.

g. When USDA project cooperation is involved directly in the development and release of the variety, the release of information is accomplished in cooperation with the Assistant Administrator, Plant and Entomological Sciences SEA-AR, or the SCS, or other USDA agency. This agency will send appropriate letters of transmittal to the Experiment Station Director(s) of the state(s) involved for their concurrence.

h. If USDA projects or personnel are not directly involved, the preparation and dissemination of release information initiated by the project leader proceeds singularly and directly through the appropriate personnel of the Department, the Iowa Agriculture Experiment Station, the Committee for Agricultural Development, and the Information Service of Iowa State University.

i. A time for simultaneous news release relative to the new variety is established with cooperating states or federal agencies regardless of which of the two release alternatives (g, h) is implemented. To insure wide dissemination of the release information pertaining to new varieties, hybrids, or genetic stocks, a copy of the information released by the Director of the Experiment Station shall be sent to the Executive Secretary, National Council of Commercial Plant Breeders and to the Executive Secretary, American Seed Trade Association at the same time that it is disseminated to the state and federal agencies. For certain materials, such as genetic stocks of rather restrictive value, a selective information release may be made to appropriate agencies rather than a general news release.

6. If appropriate for the crop and type of germplasm or variety being released, the project leader prepares a varietal registration paper and sends it to the Chairman of the Subcommittee for the specific crop on the Crop Science Society of American Committee on Varietal Registration, or to a similar body in another appropriate society. Registration papers are commonly submitted for new varieties of the self-pollinated grain crops, forage grasses, and legumes; for genetic stocks; for parental lines of hybrids; and for synthetics. The initiation of varietal registration papers should be left to the discretion of the project leader.
7. Concurrent with submission of the varietal registration paper, a sample of seed of a newly released variety, parental inbred line, or genetic stock must be supplied to the National Seed Storage Laboratory, Fort Collins, Colorado, by the project leader. Even though a varietal registration paper is not prepared, the project leader should supply the sample of seed at the same time the variety is officially released.

New Variety Release Procedures—Project Leader

1. Prepares statement of intent to release a new variety and an offer of limited seed for testing. This statement should be disseminated one year before the proposal for release is initiated in Iowa. The statement should be sent to the project leader's department head and to his project (crop) counterparts in other states where the new variety may be expected to be produced. Notification may not be necessary or appropriate for genetic stocks or specific inbred parental lines.

2. Prepares proposal for release, together with performance data and other pertinent information about the selection, and transmits the information to the Department's Variety Release Committee via the Department Head.
3. If proposal to release is approved by the department committee, the project leader submits the release proposal and information, via his Department Head, to the Associate Director of the Iowa Agriculture Experiment Station.
4. If release of the variety is recommended by an *ad hoc* Variety Release Committee of the Iowa A.E.S. and by the Associate Director, the project leader proceeds as follows:
   a. If SEA-AR, SCS, or other USDA agency cooperation is involved directly in the development of the variety, the release proposal and information is transmitted by the Associate Director of the Iowa A.E.S. (in accordance with SEA-AR Administrative Memorandum 950.1 on preparation of joint release notices) to the Area Director of SEA-AR and to the SCS, or other USDA agency involved for their recommendation relative to joint release of the variety. The project leader and USDA personnel on the project will be informed of the USDA recommendation and may be called upon to amplify or supply additional information pertinent to a joint release.
   b. Investigates the prior use of the proposed variety name and possible conflicts with trademark or patent regulations.
   c. For crops where a review board is established, the project leader obtains forms from the Chairman of the National Certified Review Board and provides the information and performance data requested to the chairman of that board.
   d. Makes arrangements cooperatively with the Production Manager, Committee for Agricultural Development, Iowa A.E.S. for increase of foundation seed.
   e. Prepares and sends, cooperatively with the Production Manager, C.A.D., Iowa A.E.S., an offer to share foundation seed. This offer is sent to the project leader's counterparts in other states where the new variety may be expected to be produced. Seed for increase should be offered to other states only one year in advance of the release of foundation seed to Iowa seed growers.
   f. If variety protection is recommended by the experiment station policy for the type of crop and seed, the project leader obtains the current forms from the Plant Variety Protection Office, supplies the information requested, and submits the application to the Associate Director of the Iowa A.E.S. for approval and transmittal to the Plant Variety Protection Office.
   g. The project leader supplies information for publicity release through the appropriate personnel of the Department, the Iowa A.E.S., and the Information Service of Iowa State University. If SEA-AR, SCS, or other USDA agency cooperation is involved directly in the development and release of the variety, the project leader works either directly, or indirectly through USDA personnel on the project with the Associate Director of the Iowa A.E.S., in disseminating the release information to the USDA agency. Timing of the publicity release for a variety developed with direct USDA agency participation is determined in cooperation with the Assistant Administrator, Plant and Entomological Sciences, SEA-AR, or the SCS.
   h. If appropriate for the crop and type of germplasm or variety being released, the project leader prepares a varietal registration paper and sends it to the Chairman of the Subcommittee for the specific crop of the Crop Science Society of America Committee on Varietal Registration, or to a similar body in another appropriate society.
   i. Concurrent with submission of the varietal registration paper, the project leader sends a sample of seed of the newly released variety, parental inbred line, or genetic stock to the National Seed Storage Laboratory (NSSL), Fort Collins, Colorado. Even though a varietal registration paper is not prepared, a sample of the seed should be sent to the NSSL at the time the variety is officially released.

New Variety Release Procedures—Department Head

1. Receives proposal for variety release from research project leader, and transmits proposal to Department's Variety Release Committee for evaluation and recommendation.
2. If the Department Variety Release Committee recommends release of the variety, the Department Head obtains the release proposal and information from the project leader for the crop and sends, with his recommendation, to the Associate Director of the Iowa Agriculture Experiment Station.
3. Department Head receives the recommendation of the Associate Director (and the *ad hoc* Variety Release Committee of the Iowa A.E.S.) relative to release of the variety. If release is recommended, the Department Head requests the project leader to continue with the activities necessary for seed increase and release.
4. If a varietal registration paper is prepared, the Department Head receives the completed forms for submission to the appropriate journal, plus the manuscript for review. He completes the necessary processing for approval of publication and returns the manuscript and forms to the project leader.

New Variety Release Procedures—Associate Director

1. If a new variety release receives approval by a Department's Variety Release Committee and the Department Head, the Associate Director receives the release proposal.
2. The Associate Director appoints an *ad hoc* committee within the Experiment Station to evaluate the proposal and make a recommendation relative to release of the variety.
3. After receiving the recommendation of the *ad hoc* Review Committee, the Associate Director returns his recommendation relative to release to the Department Head. Concurrently, if SEA-AR, SCS, or other USDA agency cooperation is involved directly in the development of the variety, the Associate Director also transmits the performance data and supporting information together with his recommendation for release to the Assistant Administrator, Plant and Entomological Sciences, SEA-AR, or the SCS of the USDA for their recommendation relative to making a joint release of the variety.
4. If release is recommended, and if variety protection is requested, the Associate Director receives the forms to request protection from the project leader involved and submits them to the Plant Variety Protection Office for consideration.
5. Receives documents from the Department Head that are necessary for the release and distribution of seed, and for the dissemination and publicity, through the appropriate agencies of Iowa State University and the Agri. Expt. Stn. for his approval and signatures prior to their distribution.
6. If SEA-AR, SCS, or other USDA agency cooperation is involved directly in the development and release of the variety, the Associate Director receives, either from the project leader or USDA personnel associated with the project, the information for publicity release for transmittal to the Assistant Administrator, Plant and Entomological Sciences, SEA-AR, or the SCS of the USDA, in order that timing of the publicity release may be coordinated among the agencies involved.
7. If a varietal registration paper is prepared, the Associate Director receives, via the Department Head, the forms for submission to the appropriate journal, plus the manuscript for review. He completes the necessary processing and returns the materials to the project leader.

APPENDIX D

Request for Release and Distribution of Plant Variety

Iowa Agricultural Experiment Station

Approval is hereby requested for release and distribution of the following variety:

Soybean strain A74-302012

Identification (Name and/or Number)

A74-302012 is a strain number. The name Pella has been proposed for the variety.

Pedigree

A74-302012 is an F_4 plant selection from the cross L66L-137 × Calland. L66L-137 is a line developed at the Illinois Agricultural Experiment Station. Calland is a variety developed at the Indiana Agricultural Experiment Station.

Origin

A74-302012 was developed by Project 2118, Department of Agronomy, Iowa State University.

Description (Taxonomic)

A74-302012 has purple flowers, tawny pubescence, tan pods, dull seed coat luster, yellow seed coat, and black hilum.

Performance

The agronomic performance of A74-302012 is compared with five commercial varieties in the following tables. The data are not complete for all comparisons in Iowa because the varieties were not always grown in the same test.

Reasons for Distribution

A74-302012 has several attributes that should be useful to Iowa farmers. (1) Its maturity is earlier than public varieties currently available for southern Iowa such as Williams, Woodworth, Oakland, and Cumberland. The earlier maturity will be useful to farmers in the south-central tiers of counties that heretofore have had to choose between an early variety like Beeson or a later variety like Woodworth. (2) The strain has resistance to race 1 of phytophthora rot. Its yield has been superior to Oakland and Calland, the two public varieties with similar resistance. (3) The strain has tolerance to all known races of phytophthora rot that is superior to public varieties of similar maturity.

Proposed Methods of Distribution

There were 300 bushels of breeder seed of A74-302012 produced in Iowa during 1978. The seed will be distributed to interested states for production of foundation seed in 1979. The foundation seed will be distributed to certified growers in 1980 for production of registered seed that can be sold to farmers for planting in 1981.

Publicity release will be August 15, 1979.

Recommended

_____ _____

Head of Department Date

_____ _____

Chairman, Review Committee Date

Approved

_____ _____

Director, Agricultural Experiment Station Date

United States Patent

United States Patent [19] [11] **Plant 4,653**

Buck [45] **Feb. 17, 1981**

[54] **GERANIUM PLANT NAMED SUPER-WALTZTIME**

[75] Inventor: **Griffith J. Buck**, Ames, Iowa

[73] Assignee: **Iowa State University Research Foundation, Inc.**, Ames, Iowa

[21] Appl. No.: **112,114**

[22] Filed: **Jan. 14, 1980**

[51] **Int. Cl.**[3] **A01H 5/00**

[52] **U.S. Cl.** **Plt./68**

[58] **Field of Search** PLT./68

Primary Examiner—James R. Feyrer

Attorney, Agent, or Firm—Chas. W. Rummler

[57] **ABSTRACT**

A new cultivar of geranium plant distinguished by flowers that have a delicate pink coloration that intensifies under high temperature and light intensities, the very large size of its inflorescence clusters, and a continuous and abundant flowering habit throughout the year with adequate length of photoperiod. This new plant is more compact and free branching and, because of its greater number of stems and a consistent tendency to produce flowers on a 2-4 node cycle, has a greater flowering potential than its predecessors.

1 Drawing Figure

1

BACKGROUND OF THE NEW PLANT

My new geranium plant originated as a seedling of "Skylark" × "Waltztime", both unpatented, the cross having been made by me at Iowa State University at Ames, Iowa, in the course of breeding efforts carried on by me since 1956 with the object of developing improved geranium cultivars having better adaptability to the summer climates of the upper Midwest of the United States, including tolerance to the high summer night temperatures and humidity and a tolerance to *Botrytis cinerea* infection. This new plant was selected by me for propagation because of the color character of its inflorescence and its apparent fulfillment of my principal objectives and propagation under my direction through successive generations by means of cuttings at the Iowa State University horticultural greenhouses has shown that its distinctive and novel characteristics hold true from generation to generation and appear to be firmly fixed. Propagation of this new geranium plant for the commercial market is now being done by meristem culture and cuttings at Connellsville, Pa.

DESCRIPTION OF THE DRAWING

My new geranium plant is illustrated by the accompanying full color photograhic drawing which shows a potted plant in full bloom, the colors shown being as nearly true as it is reasonably possible to obtain by conventional commercial photographic procedures.

2

Form: Bush.

Height: 25 to 40 cm. (25 cm. as a 4 inch pot plant)

Growth: Compact and vigorous

Habit: Erect and free-branching with sturdy, strong stems.

Foliage

Quantity.—Abundant

Leaves.—Size: Medium large, about 10 to 11 cm. long × 7.5 to 9.5 cm. wide. Shape: Round-cordate with several rounded lobes and serrated margins. Texture: Firm and slightly velvety to the touch. Color: Upper side—138A with central zone of 146B. Under side—138B.

Petioles.—Length: 9 to 14 cm.

THE BUD

Size: 14 to 16 mm. long and 9 to 11 mm. wide

Shape: Pointed ovoid

Opening: Buds open slowly

Color

When sepals first divide.—154D

When petals begin to unfurl.—154D suffused with 41C

Sepals: At first, erect, and later curling back

Shape.—Long-pointed ovate

Color.—Inside: 146D. Outside: 146C veined with 180A.

Calyx

Aspect.—Hairy

DESCRIPTION OF THE NEW PLANT

The following is a detailed description of my new geranium cultivar with color designations according to The R.H.S. Colour Chart published by The Royal Horticultural Society of London, England, the data having been obtained from observations of the plants of this new cultivar grown in the horticultural greenhouses of Iowa State University at Ames, Iowa.

THE PLANT

Origin: Seedling.

Parentage:

Seed parent.—"Skylark" (unpatented)

Pollen parent.—"Waltztime" (unpatented).

Classification:

Botanic.—Pelargonium × Hortorum, Bailey.

Commercial.—Garden geranium.

Peduncle: Strong and erect.

Length.—15 to 22 cm.

Aspect.—Hairy.

Color.—146B.

THE FLOWER

Flowering habit: Continuous and abundant throughout the year with adequate length of photoperiod.

Inflorescence:

Type.—Umbel.

Size.—Very large.

Diameter.—10 to 13 cm.

Depth.—6 to 8 cm.

Shape.—Semi-globular.

Number of florets or buds.—50 to 60.

Peduncle.—Sturdy and upright. Length: 15 to 25 cm. Color: 138A.

Plant 4,653

3

Florets.—Shape: When bloom first opens—Cup-shaped. The cup flattens to saucer-shape as bloom matures. Petals: Number: 9 to 14, including petaloids. Form: Obovate to spatulate. Arrangement: Slightly imbricated. Color: Spring: White lightly suffused and veined with RHS 41C and a suggestion of a basal blotch of RHS 33A. Summer-Fall: White ground suffused with RHS 41C and developing a margin of RHS 42A. 33A at base of petal and extending into upper half of petal. Winter: White suffused with RHS 41C with a basal blotch of RHS 33A. Reverse Side of Petals: White suffused with RHS 154D; tinted and veined with RHS 41C. Petaloids: Number: 1 to 5. Size: 1.5 to 2.0 cm. Color: Same as petals. Pedicel: Length: 2.0 to 3.1 cm. Strength: Good.

Effect of weather: None

Persistence: Florets hang on and dry

Disease resistance: Tolerant to *Botrytis cinerea* as observed in area where the disease is prevalent.

Lasting quality: 7 days.

REPRODUCTIVE ORGANS

Stamens:

Anthers.—5 to 8 in number. Length: 3 to 4 mm. Arrangement: Cylindrical.

4

Filaments.—Length: 5 to 6 mm. Color: White.

Pollen.—Color—Reddish-Brown.

Pistils: Number—1.

Styles.—8 to 9 mm. long.

Stigma.—Color—Red-Brown.

Fruit: Partially fertile.

Shape.—Ovoid with a long beak.

Color at maturity.—Brownish-Black.

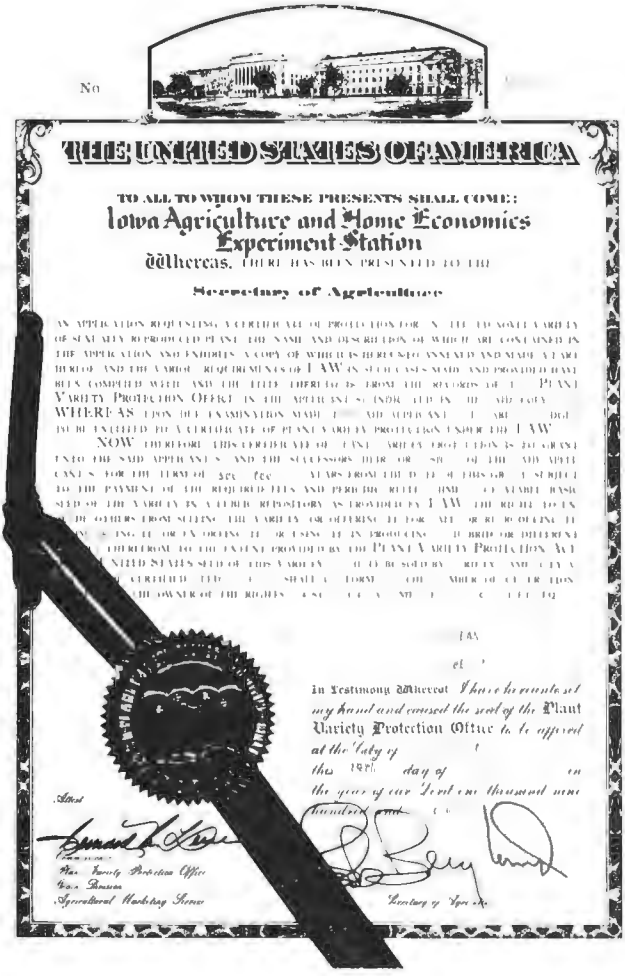
This geranium is similar in growth habit and cultural requirements to the older cultivars "Waltztime" and "Skylark". The flower color is in the same general color range of those cultivars but differs from them in that the color intensifies under high temperatures and high light intensities. This new plant is more compact and free branching, and because of its greater number of stems and a consistent tendency to produce flowers on a 2-4 node cycle, it has a greater flowering potential than the earlier cultivars.

I claim:

1. A new and distinct cultivar of geranium plant substantially as herein shown and described, characterized by a vigorous and much branched growth habit and a continuous and abundant year around flowering under photoperiod culture.

* * * * *

Plant Variety Protection Certificate and Application



No

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

Iowa Agriculture and Home Economics Experiment Station

Whereas, there has been presented to the

Secretary of Agriculture

In Testimony Whereof I have hereunto set my hand and caused the seal of the Plant Variety Protection Office to be affixed at the City of this day of in the year of our Lord one thousand nine hundred and

Attest

Plant Variety Protection Office

U.S. Department of Agriculture

Secretary of Agriculture

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
LIVESTOCK, POULTRY, GRAIN & SEED DIVISION

APPLICATION FOR PLANT VARIETY PROTECTION CERTIFICATE

INSTRUCTIONS: *See Reverse.*

FORM APPROVED
OMB NO. 40-R3822

No certificate for plant variety protection may be issued unless a completed application form has been received (5 U.S.C. 553).

1a TEMPORARY DESIGNATION OF VARIETY	1b VARIETY NAME	FOR OFFICIAL USE ONLY PV NUMBER	
A75-102032	Weber		
2 KIND NAME Soybean	3. GENUS AND SPECIES NAME Glycine max.	FILING DATE	TIME A.M. P.M.
4 FAMILY NAME (BOTANICAL) Leguminosae	5. DATE OF DETERMINATION August 31, 1979	FEE RECEIVED $ _____ $ _____	DATE _____ _____

6 NAME OF APPLICANT(S)	7. ADDRESS (*Street and No. or R.F.D. No., City, State, and ZIP Code*)	8. TELEPHONE AREA CODE AND NUMBER
Iowa Agriculture and Home Economics Experiment Sta.	104 Curtiss Iowa State University Ames, IA 50011	515-294-4762

9 IF THE NAMED APPLICANT IS NOT A PERSON, FORM OF ORGANIZATION (*Corporation, partnership, association, etc.*)	10 IF INCORPORATED, GIVE STATE AND DATE OF INCORPORATION	11. DATE OF INCORPORATION
State Experiment Station		

12 NAME AND MAILING ADDRESS OF APPLICANT REPRESENTATIVE(S), IF ANY, TO SERVE IN THIS APPLICATION AND RECEIVE ALL PAPERS
John P. Mahlstede
ISU - 104 Curtiss
Ames, IA 50011

13 CHECK BOX BELOW FOR EACH ATTACHMENT SUBMITTED:

- [X] 13A. Exhibit A, Origin and Breeding History of the Variety (*See Section 52 of the Plant Variety Protection Act.*)
- [X] 13B Exhibit B, Novelty Statement.
- [X] 13C Exhibit C, Objective Description of the Variety (*Request form from Plant Variety Protection Office.*)
- [ ] 13D Exhibit D, Additional Description of the Variety.

14a DOES THE APPLICANT(S) SPECIFY THAT SEED OF THIS VARIETY BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SEED? (*See Section 83(a) (If "Yes," answer 14B and 14C below.)*) [X] YES [ ] NO

14b DOES THE APPLICANT(S) SPECIFY THAT THIS VARIETY BE LIMITED AS TO NUMBER OF GENERATIONS?	14c. IF "YES," TO 14B, HOW MANY GENERATIONS OF PRODUCTION BEYOND BREEDER SEED?
[X] YES [ ] NO	[X] FOUNDATION [X] REGISTERED [X] CERTIFIED

15a DID THE APPLICANT(S) FILE FOR PROTECTION OF THIS VARIETY IN OTHER COUNTRIES? [ ] YES [X] NO (*If "Yes," give name of countries and dates.*)

15b HAVE RIGHTS BEEN GRANTED THIS VARIETY IN OTHER COUNTRIES? [ ] YES [X] NO (*If "Yes," give name of countries and dates.*)

16 DOES THE APPLICANT(S) AGREE TO THE PUBLICATION OF HIS/HER (THEIR) NAME(S) AND ADDRESS IN THE OFFICIAL JOURNAL? [X] YES [ ] NO

17 The applicant(s) declare(s) that a viable sample of basic seed of this variety will be furnished with the application and will be replenished upon request in accordance with such regulations as may be applicable.

The undersigned applicant(s) is (are) the owner(s) of this sexually reproduced novel plant variety, and believe(s) that the variety is distinct, uniform, and stable as required in Section 41, and is entitled to protection under the provisions of Section 42 of the Plant Variety Act.

Applicant(s) is (are) informed that false representation herein can jeopardize protection and result in penalties.

_____ (DATE) _____ (SIGNATURE OF APPLICANT)

_____ (DATE) _____ (SIGNATURE OF APPLICANT)

FORM GR-470 (1-81)

Exhibit A

Origin and Breeding History of the Variety. Weber is an F_5 plant selection from the cross C1453 × Swift. C1453 is a line developed by the USDA-SEA and Purdue University Agriculture Experiment Station from the cross C1266R × C1253. C1266R is a

selection from Harosoy × C1079, C1253 is from Blackhawk × Harosoy, and C1079 is from Lincoln × Ogden. F_5 seed was obtained by the Iowa Agriculture and Home Economics Experiment Station from Improved Variety Research, Inc. who made the cross and advanced it to the F_5 generation by single-seed descent in Iowa, Hawaii, and Puerto Rico. Progeny of F_5 plants were evaluated in 1973 for iron deficiency chlorosis on calcareous soil and the line had an adequate level of resistance. It was tested for yield in Iowa during 1974 and 1975, and in the Northern Regional Soybean Tests from 1976 to 1978 under the designation A75-102032.

Seed of Weber was increased in Iowa in 1978 and distributed to foundation seed organizations in states participating in its release. Foundation seed was produced in 1979. Foundation seed will be distributed to certified seed growers for planting in 1980.

The seed of Weber has met the purity standards for foundation seed. To meet this standard, a variety cannot have over 0.1% off-types or variants present.

Weber has shown evidence of stability. The attached data indicate a stable variety.

From Regional Summary of Uniform Test I

Strain	Yield (bu/A)	Rank No.	Maturity Date	Lodging Score	Height (in.)	Seed Quality Score	Seed Size (g/100)	Seed Composition	
								Protein (%)	Oil (%)
	1978								
No. of Tests	13	13	12	13	12	9	12	6	6
Coles	40.1	11	+6.2	2.2	38	2.1	19.5	42.3	20.2
Corsoy (II)	40.5	10	+7.8	2.0	37	2.4	16.3	41.4	20.5
Evans (0)	34.9	13	−6.3	1.2	30	2.9	16.2	40.3	22.2
Harlon	36.8	12	−5.2	1.6	34	2.5	17.4	39.6	21.8
Hodgson 78 (I)	41.7	5	9-20*	1.5	34	2.2	17.6	39.4	22.1
Weber	42.8	3	+4.2	1.8	36	2.3	13.7	40.2	21.4
	1977–1978, 2-year mean								
No. of Tests	28	28	25	28	26	20	24	12	12
Coles	41.4	5	+6.9	2.3	39	2.1	19.2	41.1	20.2
Corsoy (II)	42.5	3	+7.4	2.2	38	2.3	16.1	40.0	20.6
Evans (0)	34.3	7	−7.8	1.4	31	2.5	15.6	39.2	22.2
Harlon	36.3	6	−5.6	1.8	35	2.4	16.8	38.7	21.8
Hodgson 78 (I)	41.5	4	9-17.5*	1.7	34	2.1	17.0	38.4	22.2
Weber	44.6	1	+4.8	2.0	36	2.1	14.0	39.0	21.4

*118 days after planting.

*119 days after planting.

From Regional Summary of Uniform Test I

Cultivar	Yield (bu/A)	Maturity Date	Lodging Score*	Height (in.)	Chlorosis Score+	Seed Size (g/100)	Seed Content	
							Protein (%)	Oil (%)
Weber	44.6	Sept. 22	2.0	36	1.8	14.0	39.0	21.4
Hodgson 78	41.5	Sept. 18	1.7	34	2.0	17.0	38.4	22.2
Coles	41.4	Sept. 24	2.3	39	2.8	19.2	41.1	20.2
Corsoy	42.5	Sept. 25	2.2	38	3.6	16.1	40.0	20.6

*Scores range from 1 (plants erect) to 5 (plants prostrate).

+ Scores range from 1 (very good) to 5 (very poor).

Exhibit B

Novelty Statement. Weber most closely resembles Corsoy and Chippewa. Weber has white flowers, tawny pubescence, brown pods, a dull yellow seed coat and a black hilum. Corsoy has purple flowers, grey pubescence, brown pods, dull yellow seed coat and a yellow hilum. Chippewa has purple flowers, tawny pubescence, brown pods, shiny yellow seed coat and a black hilum. Weber has a seed size of 14.0 g/100 seeds, and Corsoy has 16.1 g/100 seeds.

Weber is 3 days earlier in maturity than Corsoy, and has a 5% higher yield. It has similar height and lodging scores as Corsoy. Weber is 1% lower in protein and 0.8% higher in oil and is 2.1 g/100 seeds smaller in size. Weber also has moderate resistance to iron chlorosis while Corsoy is susceptible.

Weber's unique combination of small seed size, chlorosis resistance and other traits listed on this form distinguish it from other varieties.

FORM GR-470-2 (6-15-72)

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
GRAIN DIVISION
HYATTSVILLE, MARYLAND 20782

EXHIBIT C (Soybean)

OBJECTIVE DESCRIPTION OF VARIETY
SOYBEAN (*GLYCINE MAX*)

INSTRUCTIONS See Reverse.

NAME OF APPLICANT(S)
Iowa Agriculture and Home Economics Experiment Station

ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP Code)
104 Curtiss
Iowa State University
Ames, IA 50011

FOR OFFICIAL USE ONLY
PVPO NUMBER
VARIETY NAME OR TEMPORARY DESIGNATION

Place the appropriate number that describes the varietal character of this variety in the boxes below.

1. SEED SHAPE:
[1] 1 = SPHERICAL 2 = SPHERICAL FLATTENED 3 = ELONGATE 4 = OTHER (Specify)

2. SEED COAT COLOR:
[1] 1 = YELLOW 2 = GREEN 3 = BROWN 4 = BLACK 5 = OTHER (Specify)
SHADE: [2] 1 = LIGHT 2 = MEDIUM 3 = DARK

3. SEED COAT LUSTER:
[1] 1 = DULL 2 = SHINY

4. SEED SIZE
[1][4] GRAMS PER 100 SEEDS

5. HILUM COLOR
[6] 1 = BUFF 2 = YELLOW 3 = BROWN 4 = GRAY 5 = IMPERFECT BLACK 6 = BLACK 7 = OTHER (Specify)
SHADE: [2] 1 = LIGHT 2 = MEDIUM 3 = DARK

6. COTYLEDON COLOR: [1] 1 = YELLOW 2 = GREEN

7. LEAFLET SIZE (See Reverse): [2] 1 = SMALL 2 = MEDIUM 3 = LARGE

8. LEAFLET SHAPE: [1] 1 = OVATE 2 = OBLONG 3 = LANCEOLATE 4 = ELLIPTICAL 5 = OTHER (Specify)

9. LEAF COLOR (See reverse): [1] 1 = LIGHT GREEN 2 = MEDIUM GREEN 3 = DARK GREEN

10. FLOWER COLOR: [1] 1 = WHITE 2 = PURPLE 3 = OTHER (Specify)

11. POD COLOR: [2] 1 = TAN 2 = BROWN 3 = BLACK

12. POD SET: [1] 1 = SCATTERED 2 = CONCENTRATED

13. PLANT PUBESCENCE COLOR: [2] 1 = GRAY 2 = BROWN 3 = OTHER (Specify)

SHADE: [2] 1 = LIGHT 2 = MEDIUM 3 = DARK

14. PLANT TYPES (See Reverse): [3] 1 = SLENDER 2 = BUSHY 3 = INTERMEDIATE

15. PLANT HABIT: [2] 1 = DETERMINATE 2 = INDETERMINATE 3 = OTHER (Specify)

16. HYPOCOTYL COLOR: [1] 1 = GREEN 2 = PURPLE

17. SEED PROTEIN: [-] 1 = A 2 = B

18. NUMBER OF DAYS TO FLOWERING (Place a zero in first box (e.g. [0][8]) when days are 9 or less.) [3][8] after emergence

19. MATURITY GROUP [3] 1 = 00 2 = 0 3 = I 4 = II 5 = III 6 = IV 7 = V 8 = VI 9 = VII 10 = VIII

20. SIZE OF 10 DAY OLD SEEDLING GROWN UNDER CONSTANT LIGHT (Growth Chamber) AT 25° C. (Place a zero in first box (e.g. [0][2]) when size is 9 mm. or less.)

[1][0][9] MM. LENGTH OF SEEDLING [1][8] MM. LENGTH OF COTYLEDON [1][1] MM. WIDTH OF COTYLEDON

21. DISEASE: (Enter 0 = Not Tested; 1 = Susceptible, 2 = Resistant)

[0] BACTERIAL PUSTULE	[0] SOYBEAN CYST	[0] DOWNY MILDEW	[2] PURPLE STAIN	[2] POD AND STEM BLIGHT	[0] ROOT KNOT
[1] FROGEYE	[0] STEM CANKER	[1] PHYTOPHTHORA	[1] BROWN STEM ROT	[0] TARGET SPOT	[0] BROWN SPOT
[0] BUD BLIGHT	[0] WILDFIRE	[0] RHIZOCTONIA ROT	[2] OTHER (Specify) Iron chlorosis		

FORM GR-470-2 (REVERSE)

22. INDICATE WHICH VARIETY MOST CLOSELY RESEMBLES THAT SUBMITTED.

CHARACTER	NAME OF VARIETY	CHARACTER	NAME OF VARIETY
Plant shape	Corsoy	Petiole angle	-
Leaf shape	Hark	Seed size	Chippewa
Leaf color	Sloan	Seed shape	Rampage
Leaf surface	Corsoy	Seedling pigmentation	-

23. GIVE DATA FOR SUBMITTED AND SIMILAR STANDARD VARIETY

VARIETY	NO. OF DAYS TO MATURITY	LODGING SCORE	PLANT HEIGHT	LEAF SIZE		CONTENT		AVERAGE NO. OF PODS PER PLANT	IODINE NO.
				Width	Length	Protein	Oil		
Submitted Weber	124*	2.1	36	-	-	39%	21.4 %	-	-
Name of similar variety Corsoy	127*	2.3	38	-	-	40%	20.6 %	-	-

* after planting

INSTRUCTIONS

GENERAL: The following publications may be used as a reference aid for completing this form:

1. Scott, Walter O. and Samuel R. Aldrich, 1970, Modern Soybean Production, The Farmer Quarterly.
2. Norman, A. G., 1963, The Soybean: Genetics, Breeding, Physiology, Nutrition, Management.
3. McKie, J. W., and K. L. Anderson, 1970, The Soybean Book.

LEAF COLOR Nickerson's or any recognized color fan may be used to determine the leaf color of the described variety. The following Soybean varieties may be used as a guide to identify the colors listed on the form.

COLOR	VARIETY
Light Green	"Ada"
Medium Green	"Wilkin"
Dark Green	"Swift"

LEAF SIZE The following varieties may be used as a guide to identify the relative size leaves.

SIZE	VARIETY
Small	"Amsoy"
Medium	"Bonus"
Large	"Anoka"

PLANT TYPE. The following varieties may be used as a guide to identify the plant type.

TYPE	VARIETY
Slender	"Vansoy"
Intermediate	"Wirth"
Bushy	"Adelphia"

APPENDIX G

Facts About Naming and Labeling Varieties of Seed

Every year many new varieties of agricultural and vegetable seed reach America's marketplace. New seed varieties, when added to varieties already on the market, provide farmers and home gardeners with a wide selection of seed. But, in order for them to buy intelligently, seed must be correctly named and labeled. This is not always done.

Marketing a product by its correct name might seem to be the most likely way to do business. However, U.S. Department of Agriculture (USDA) seed officials have found that seed, unfortunately, is sometimes named, labeled, or advertised improperly as it passes through marketing channels.

Marketing seed under the wrong name is misrepresentation. It can lead to financial loss for several participants in the seed marketing chain.

The farmer, for example, buys seed to achieve specific objectives such as increased yield, competitiveness in a specialized market, or adaptability to growing conditions of a specific region. If seed is misrepresented and the farmer buys seed other than what was planned, the harvest may be less valuable than anticipated, or worse yet, there may not even be a market for the crop.

In one case, a farmer bought seed to grow cabbage to be marketed for processing into sauerkraut. As the cabbage matured, the farmer found that his crop was not suitable for processing and even worse, that he had no market for the cabbage in his fields. In this case financial hardship was brought about by improper variety labeling.

Seed companies and plant breeders also suffer in a market where problems with variety names exist. For instance, if the name of a newly released variety is misleading or confusing to the potential buyer, the variety may not attract the sales that it might otherwise.

This fact sheet outlines requirements for naming agricultural and vegetable seed. It is based on the Federal Seed Act, a truth-in-labeling law intended to protect farmers and home gardeners who purchase seed. Exceptions to the basic rules and the do's and don'ts of seed variety labeling and advertising also are explained.

Reprinted, by permission, from Agriculture Marketing Service, Naming and labeling varieties of seed, U.S. Department of Agriculture, AMS-592. Revised October 1981.

Who Names New Varieties?

The originator or discoverer of a new variety may give that variety a name. If the originator or discoverer can't or chooses not to name a variety, someone else may give that variety a name for marketing purposes. In such a case, the name first used when the seed is introduced into commerce will be the name of the variety.

It is illegal to change a variety name once the name has been legally assigned. In other words, a buyer may not purchase seed labeled as variety "X" and resell it as variety "Y." An exception to this rule occurs when the original name is determined to be illegal. In such an instance, the variety has to be renamed according to the rules mentioned above. Another exception to this rule applies to a number of varieties which were already being marketed under several names before 1956. (See section on synonyms.)

What's in a Name?

To fully understand what goes into naming a variety, you need to know the difference between a "kind" of seed and a seed "variety."

"Kind" is the term used for the seed of one or more related plants known by a common name such as carrot, radish, wheat, or soybean.

"Variety" is a subdivision of a kind. A variety has different characteristics from another variety of the same kind of seed. For example, "Oxheart" carrot and "Danvers 126" carrot or "Bragg" soybean and "Ransom" soybean.

The rules for naming plants relate to both kinds and varieties of seed:

1. A variety must be given a name that is unique to the kind of seed to which the variety belongs. For instance, there can only be one variety of wheat named "Prairie Road."
2. Varieties of two or more different kinds of seed may have the same name if the kinds are not closely related. For example, there could be a "Prairie Road" wheat and "Prairie Road" oat because wheat and oat are kinds of seed not closely related. On the other hand, it would not be permissible to have an "Alta" tall fescue and "Alta" red fescue because the two kinds of seed are closely related.
3. Once assigned to a variety, the name remains exclusive. Even if "Prairie Road" wheat has not been marketed for many years, a newly developed and different wheat variety can't be given the name "Prairie Road."
4. A company name may be used in a variety name as long as it is part of the original, legally assigned name. Once part of a legal variety name, the company name must be used by everyone including another company that might market the seed.

   When a company name is **not** part of the variety name, it should not be used in any way that gives the idea that it **is** part of the variety name. For example, Ajax Seed Company can't label or advertise "Prairie Road" wheat variety as "Ajax Prairie Road" since "Ajax" may be mistaken to be part of the variety name.

   The simplest way to avoid confusion is to separate the company and variety names in advertising or labeling.
5. Although USDA discourages it, you may use descriptive terms in variety names as long as such terms are not misleading. "GBR," for instance, is accepted among

sorghum growers as meaning "green bug resistant." It would be illegal to include "GBR" as part of a variety name if that variety were not green bug resistant. Similarly, if a sweet corn variety is named "Better Yield Bantam," the name would be illegal if this variety did not produce a higher yield than the standard Bantam sweet corn.

6. A variety name should be clearly different in spelling and in sound. "Alan" cucumber would not be permissible if an "Allen" cucumber were already on the market.

Hybrids

Remember that a hybrid also is a variety. Hybrid designations, whether they are names or numbers, also are variety names. Every rule discussed here applies to hybrid seed as well as to nonhybrid seed.

In the case of hybrids, however, the situation is potentially more complex since more than one seed producer or company might use identical parent lines in producing a hybrid variety. One company could then produce a hybrid that was the same as one already introduced by another firm.

When this happens, the same name must be used by both firms since they are marketing the same variety.

If the people who developed the parent lines have given the hybrid variety a name, that is the legal name. Otherwise, the proper name would be the one given by the company that first introduced the hybrid seed into commerce.

U.S. Department of Agriculture seed regulatory officials believe the following situation occurs far too often:

"State University" releases hybrid corn parent lines A and B.

John Doe Seed Company obtains seed of lines A and B, crosses the two lines, and is the first company to introduce the resulting hybrid into commerce under a variety name. John Doe Seed Company names this hybrid "JD 5259."

La Marque Seeds, Inc., obtains lines A and B, makes the same cross, and names the resulting hybrid variety "SML 25." There has been no change in the A and B lines that would result in a different variety. La Marque ships the hybrid seed, labeled "SML 25," in interstate commerce, and violates the Federal Seed Act because the seed should have been labeled "JD 5259."

Synonyms—Varieties with Several Names

As noted earlier, the name originally assigned to a variety is the name that must be used forever. It can't be changed unless it is illegal.

This does not mean that all varieties must be marketed under a single name. In fact, some old varieties may be marketed legally under more than one name. If several names for a single variety of an agricultural or vegetable seed were in broad general use before July 28, 1956, those names still may be used. For hybrid corn this exception applies to names in use before Oct. 20, 1951.

Here are some examples:

The names "Acorn," "Table Queen," and "Des Moines" have been known for many years to represent a single squash variety. They were in broad general use before July 28, 1956, so seed dealers may continue to use these names interchangeably.

If "Ajax 79EDX" hybrid field corn, released in 1949, also became known as "Golden Ajax 79EDX" in the late 1950s, it would be illegal to label or advertise that variety as "Golden Ajax 79EDX." If the two names had been in use before Oct. 20, 1951, the variety could then be marketed under either name.

With the exception of old varieties with allowable synonym names, all vegetable and agricultural varieties may have **only one** legally recognized name, and that name must be used by anyone who represents the variety name in labeling and advertising. This includes interstate seed shipments and seed advertisements sent in the mail or in interstate or foreign commerce.

Imported Seed

Seed imported into the United States can't be renamed if the original name of the seed is in the Roman alphabet.

For example, cabbage seed labeled "Fredrikshavn" and shipped to the United States from Denmark can't be given a different variety name such as "Bold Blue."

Seed increased from imported seed also can't be renamed. If "Fredrikshavn" were increased in the United States the resulting crop still couldn't be named "Bold Blue."

Seed with a name that is not in the Roman alphabet must be given a new name. In such a case, the rules for naming the variety are the same as stated previously.

Brand Names

USDA officials have found evidence of confusion over the use of variety names and brand or trademark names. This includes names registered with the Trademark Division of the U.S. Patent Office.

Here are some rules to keep in mind:

1. The brand or trademark name must be clearly identified as being other than part of the variety name. For example, "Red Giant Brand Arthur 71 wheat" adequately distinguishes between "Red Giant" brand and the variety "Arthur 71." "Red Giant Arthur 71 wheat," on the other hand, is not an adequate distinction.
2. A brand name must never take the place of a variety name.

   Let's say a firm uses "Super Nova" as a brand name for its line of sunflowers. This firm may not relabel or advertise variety "894" hybrid sunflower seed as variety "Super Nova" hybrid sunflower or even "Super Nova 894" variety.
3. If a brand or trademark name is part of a variety's name, the trademark loses status. Anyone marketing the variety under its name is required to use the exact, legal variety name, including brand or trademark.

   For instance, say Ajax Seed Company uses "Ajax Deluxe" as a brand or trademark for its line of vegetable seed. If the Ajax people introduce a new tomato variety named "Ajax Deluxe Cherry," they can't retain exclusive rights to that

name. If John Doe Seed Company later makes an interstate shipment of seed of this same variety, it must be labeled as "Ajax Deluxe Cherry."

Mixtures or Blends

The labeling and advertising of a varietal mixture or blend must not create the impression that the seed is a single variety.

The Federal Seed Act allows seed in mixtures or blends to be assigned a brand name but not a variety name. Either the percentages of each varietal component of the blend or the phrase "varieties not stated" must be printed on the label. This rule applies to 36 kinds of agricultural seed.

For example, if a soybean product were a blend of three varieties, the label or advertising could not read "Peninsula Soybean" because "Peninsula" could be mistaken for a variety name. The same soybeans could be sold as "Peninsula Brand Soybean Blend, Varieties Not Stated."

Vegetable seed containing more than one variety must be labeled with the name and percentage of each variety present. The "Varieties Not Stated" option can't be used.

Do Your Homework

If you are in a position to name a new variety, you should investigate the name you wish to use. You should not use a name if it has been used before, or if a confusingly similar name exists.

Let's say Ajax Seed Company is marketing a new variety of red clover called "Verdant." Unknown to Ajax, a "Verdant" red clover was released by another firm more than 18 years ago. This original "Verdant" never did become popular, and today it has all but disappeared from the marketplace. The fact that it has disappeared doesn't matter. Journals, old catalogs, or other records would prove the existence of the original "Verdant," and therefore Ajax Seed Company must rename its variety.

Researching a name to avoid potential conflict is not foolproof. The Seed Regulatory Branch in USDA's Agricultural Marketing Service can assist you in your research. However, there is no official registry of variety names, so the branch's files are incomplete. USDA can't assure you that a name is completely clear.

Summary

If the naming, labeling, and advertising of a seed variety is truthful, it is probably in compliance with the Federal Seed Act.

Keep these simple rules in mind to help eliminate violations and confusion in the marketing of seed:

- Research the proposed variety name before adopting it.
- Make sure the name cannot be confused with company names, brands, trademarks, or names of other varieties of the same kind of seed.

- Never change the variety name, whether marketing seed obtained from another source, or from your own production—for example, hybrid seed that already has a legal name.

For More Information

For more information on naming, labeling, and advertising seed, contact the Seed Regulatory Branch of the Livestock, Meat, Grain, and Seed Division, Agricultural Marketing Service, U.S. Department of Agriculture.

Write to: Seed Regulatory Branch, Rm. 2603-S, AMS, USDA, Washington, D.C., 20250, or call: (202) 447-9340.

The use of company and variety names in this guide is for illustration only and does not constitute endorsement or indictment by the U.S. Department of Agriculture.

Application for Review of Soybean Varieties for Certification

National Certified Soybean Variety Review Board

APPLICANT'S NAME Iowa Agric. & Home Econ. Expt. Station Date 1/18/80

ADDRESS Iowa State University, Ames, Iowa 50011

SPONSORING INSTITUTION (If other than applicant) _____

BREEDER'S NAME (If other than applicant) Walter R. Fehr

Variety Name Weber Experimental Designation A75-102032

The breeder, the sponsoring institution, or the organization must describe and DOCUMENT in this application those characteristics of the variety which give it distinctiveness by supplying the information requested below. Action will be deferred unless application is sufficiently documented. ANY STATED BENEFIT OR ADVANTAGES FOR THE VARIETY MUST BE SUPPORTED BY ACCEPTABLE DATA.

I. Indicate parentage (known variety or strain designation requested), breeding procedure (bulk, pedigree, etc.) and time sequence (generation) used in developing the variety. _____

II. VARIETY DESCRIPTION*

a. Maturity: 3 days earlier, or _____ days later than Corsoy
b. Flower Color: Purple _____, or White X.
c. Pubescence Color: Brown X, or Gray _____.
d. Pod Color: Black _____, Brown X, or Tan _____.
e. Seedcoat Color: Yellow X, Black _____, Brown _____, Green _____ or other (describe) _____.
f. Seed coat luster: Dull X, Shiny _____ or other _____.
g. Hilum Color: Gray _____, Yellow _____, Black X, Brown _____, Imperfect Black _____, Buff _____, or other (describe) _____.
h. Seed Shape: Round X, Elongate _____, or other (describe) _____.
i. Seed Size: Seed per lb. 3200, as compared to Corsoy which has 2800 seeds per lb.
j. Plant height, inches: 36 compared to Corsoy at 38 inches.

*Compared with another widely grown variety of somewhat similar maturity grown in the area of usage and registered with the Crop Science Society of America. All comparisons should preferably be made to one variety.

(1)

k. Lodging score: 1_____, 2 X , 3_____, 4_____, 5_____ compared to Corsoy which was 1_____, 2 X , 3_____, 4_____, or 5_____. (Based on a score of 1 = erect to 5 = lodged flat.

l. Leaf size or shape: Large _____, Medium X , Small _____, Ovate X , Oval _____, Lanceolate _____, or other (describe) _____.

m. Plant Type: Slender _____, Bushy _____, or Intermediate X .

n. Plant Habit: Determinate _____, or Indeterminate X .

o. Other plant or seed characteristics that might help identify this variety (describe) _____

p. Protein content, if known: 39.0% compared to Corsoy with 40.0 %.

q. Oil content. 21.4% compared to Corsoy with 20.6 %.

III. DISEASE REACTION (List diseases and races for which rated and mark the reaction.)

Diseases (and races)	Resistant	Moderately Resistant	Moderately Susceptible	Susceptible
a. Frog eye (Race 2)			X	
b. Brown Stem Rot			X	
c. Pod and Stem Blight		X		
d. Purple Stain		X		
e. Phytophthora (tolerance)				X
f. Phytophthora (race 1)				X
g. Chlorosis		X		
h.				

IV. INSECT REACTION (List insects and races for which rated and mark the reaction.)

Insects (and races)	Resistant	Moderately Resistant	No Resistance
a.			
b.			
c.			

V. (a) State any advantage(s) over varieties of similar maturity.

Weber has exhibited superior yield potential over Corsoy and other similar maturing varieties. On calcareous soils it has good resistance to iron deficiency chlorosis.

(b) State any distinguishing characteristics which demonstrate eligibility for certification. Weber has smaller seed size (14.0 g/100 Sd.) than Corsoy (16.1 g/100 Sd.). Weber is 1% lower in protein and .8% higher in oil.

(Note: at least one variety used for comparison shall be similar maturity and registered with the CSSA.)

VI. Performance Data (This is not mandatory, but would be of considerable value to the committee in deciding whether a variety is new and different or worthy of certification.) Yield and chemical data are required when either of these two traits is claimed as a distinctive characteristic. Note: Attach data when appropriate.

a. Performance data are X , are not _____ included with this application.

b. The data submitted are _____, are not X confidential to the committee.

VII. Tabular data concerning height, maturity, lodging, and seed size taken at or after maturity, is required. Yield and chemical composition is required only when either of these two traits is claimed as a distinctive characteristic. Data shall include appropriate check varieties registered with the CSSA. Data may be from tests conducted by private firms or Agricultural Experiment Stations, or both. Location(s) data collected All the locations growing Group I of the 1977-1978 Uniform Soybean Tests of Northern States.

PERFORMANCE DATA

Variety	No. of Tests	Height	Data Mature	Lodging Index	Seed Sz Wt./100 seeds	Oil Con-tent	% Pro-tein	Yield
See Attached Sheets								

VIII. List the geographic area or areas of adaptation of this variety Weber is of mid Group I maturity and best adapted to 43° to 44° N. Lat.

IX. State procedure for maintaining Foundation Seed, seed classes to be used, a statement as to limitations of generations that may be Certified, and any requirements or limitations necessary to maintain varietal characteristics. Seed of Weber was produced by foundation seed organizations in states participating in its release in 1979. Foundation seed will be distributed to certified seed growers for planting in 1980. This variety will be limited to 3 generations of production beyond breeder seed (ie. foundation, registered, and certified) that may be sold.

X. If this variety is accepted by Official certifying agencies, when will certified seed be offered for sale? Certified seed will be available in 1981.

XI. The Variety Review Board assumes all information on the application to be the responsibility of the originator or owner. If inaccuracies are later identified it will be the responsibility of the originator or owner to notify the Variety Review Board and to make corrections. When experimental designations are approved by the Variety Review Board and are later changed to a permanent name or number the originator or owner will notify the Variety Review Board and give them the new name and number.

XII. Is application for Plant Variety Protection contemplated? Yes X No ____ Undecided ____

At the time a variety is accepted for certification, a two pound sample seed lot of the generation, or generations, requested by the certifying agency shall be submitted to the agency by the sponsor. This lot(s) is to be retained as a control sample against which all future seed released for Certified Seed Production may be compared to establish continued trueness to variety.

XIII. The basis for determining eligibility for a Certificate of Plant Variety Protection by the PVP office is uniqueness or novelty. Descriptive data on all varieties whether protected or not is needed in determining such novelty. Please indicate below your wishes regarding such information from this application. Your decision will in no way affect deliberations of the Variety Review Board or the PVP office.

Descriptive information in this application may X, may not ___ by used by the PVP office in the varietal description data bank.

(3)

Submit twelve copies of this application and a one pound sample of the seed to:

Larry Svajgr
Manager
Indiana Crop Improvement Association
3510 U. S. 52 South
Lafayette, Indiana 47905

If printed or mimeographed material is enclosed with this application, please send twelve copies of such matter.

Please submit a short and precise description of this variety in the space provided below, as you wish it published by AOSCA. Special emphasis on characteristics serving to identify this variety from others is requested.

Weber is a soybean variety of mid Group I maturity and best adapted to approximately 43° to 44° N. Lat. In comparison with Corsoy, Weber averages 5% higher in yield, 3 days earlier in maturity, similar in height and lodging resistance. Weber is 1% lower in protein and .8% higher in oil and 2.1 g/100 seeds smaller in size. Weber has white flowers, tawny pubescence, brown pods and dull yellow seeds with black hila. The white flowers and black hila distinguish Weber from Corsoy which has purple flowers and yellow hila.

OFFICIAL COMMITTEE ACTION

Approved_____ Deferred_____ Disapproved_____

Signed_____
Chairman, National Certified Soybean
Variety Review Board

Date_____

Application for Review of Soybean Varieties for Certification

Weber is an F_5 plant selection from the cross C1453 × 'Swift.' C1453 is a line developed by the USDA-SEA and Purdue University Agricultural Experiment Station from the cross C1266R × C1253. C1266R is a selection from 'Harosoy' × C1079, C1253 is from 'Blackhawk' × 'Harosoy,' and C1079 is from 'Lincoln' × 'Ogden.'

F_5 seed was obtained by the Iowa Agriculture and Home Economics Experiment Station from Improved Variety Research, Inc., which made the cross and advanced it to the F_5 generation by single-seed descent in Iowa, Hawaii, and Puerto Rico. Progeny of F_5 plants were evaluated in Iowa in 1973 for iron deficiency chlorosis on calcareous soil, and the lines with adequate resistance were selected for yield evaluation. Weber was tested for yield in Iowa from 1974 to 1978, and in Northern Regional Soybean Tests from 1976 to 1978.

APPENDIX I

Questions Often Asked About Seed Certification

Questions often asked about certification of small grain and soybeans are listed below with brief answers. These interpretations of certification standards are supplemental to the certification requirements. The printed requirements take precedence over statements made herein.

A. The certifying agency

The Iowa Crop Improvement Association is designated by the Iowa Secretary of Agriculture as the official certifying agency in Iowa. It is a corporation composed of persons or concerns who are engaged in agricultural work in Iowa and are actively interested in crop improvement. It is *not* a government agency.

The Association establishes and administers requirements for certification and inspects the production of certified seed under those requirements.

The purposes of certification are to encourage production of: (1) high quality seed of superior varieties with high genetic purity, (2) to make known the sources of high quality seed, and (3) to encourage the use of good seed.

Varietal purity is the first consideration in seed certification but other factors such as germination and mechanical purity are also important. Fields and seed lots are rejected from certification when genetic standards are not met. Quality standards are listed as recommendations. Fields and seed lots are expected to meet quality standards but not required to meet them.

All applications for certification are made voluntarily.

B. Who can produce certified seed?

Anyone can produce certified seed provided: (1) the requirements for certification are followed, (2) there is an interest in learning how to produce certified seed, and (3) the

Courtesy of the Iowa Crop Improvement Association, Agronomy Building, Ames, Iowa, 50011.

applicant is willing to spend the time and effort needed to; *remove off-type plants from production fields, control undesirable weeds and other crop mixtures, thoroughly clean planting and harvesting equipment before using,* and *thoroughly clean conveying and conditioning equipment and storage bins before using.*

C. What are the certification requirements?

Requirements for certification are updated annually and are available from the certification office. Briefly some of the more important requirements are listed below:

Plant an eligible variety.
Plant eligible seed.
Plant the seed on eligible land.

Eligible Varieties

Eligible varieties are those varieties that are accepted by the certifying agency as meriting certification in accordance with established eligibility requirements.

Eligible seed for planting

Genetic purity should be the first concern when purchasing seed for planting. A listing of certified seed growers is published each year and is available from the Association.

Foundation seed is eligible for planting and may be obtained from the Committee for Agricultural Development, Agronomy Building, Iowa State University, Ames, Iowa, or from the developer of a private variety. **Registered** seed is eligible for planting and may be purchased from other growers or seedsmen. **Certified** (i.e., the class of certified seed) is not eligible for planting to produce certified seed.

Eligible Land

The previous crop grown must be different from the one being produced. The land should be fertile to assure a reasonable yield of high quality seed. The land should also be relatively free of weeds.

D. What are the four classes of certified seed?

Breeder seed—This is seed which is in the hands of the developer or plant breeder.

Foundation seed originates from breeder seed. In Iowa it is produced by the Committee for Agricultural Development or the developer.

Registered seed must be grown from foundation, cleaned by the applicant or an approved seed conditioner, and bagged, when sampled and tagged and sealed when offered for sale. (Sealing is optional under certain conditions.)

Certified seed is usually grown from registered seed but may be grown from foundation seed. Certified seed must be cleaned by the applicant or an approved conditioner. Certified seed must be bagged, tagged, and sealed when sold (sealing is optional under certain conditions). *Exception:* Certified seed may be sold in bulk only by grower-applicants and/or Approved Seed Conditioners who sell directly to the consumer who will plant the seed. Bulk Retail Sales Certificates are to be used for bulk sales instead of blue certification tags.

E. What is meant by the term "limited generation"?

Limited generation is a system of controlling the number of generations of seed increased from foundation seed. The classes of seed of small grain and soybean recognized under the limited generation system are Foundation, Registered, and Certified. The certified class of seed is not eligible to be used as planting stock to produce additional generations of certified seed.

F. The steps of seed certification

There are three important steps in seed certification:

Production
Conditioning and Bagging
Merchandising

Growers considering seed certification for the first time should give careful consideration to each of these steps before planting time.

Rule of Thumb: **Do not attempt to produce certified seed unless it is known before planting how the seed will be conditioned and merchandised.**

Production: Growers who produce seed on their own land may find the production of certified seed the easiest step. Seedsmen who contract with others for the production of certified seed often find this a difficult step. A farmer grower working with a seedsman who specializes in conditioning and merchandising is often a good combination in making certified seed available to farmers.

Conditioning and Bagging Requires: adequate equipment (know equipment needs in advance), know-how (trained operators), time and labor, bulk and bag storage (clean, safe and easily accessible), and ability to keep records.

Merchandising Requires: knowledge of the market, sales ability, facilities for storage and delivery, financing, a system of bookkeeping, billing and collecting, and advertising and commissions.

Often arrangements can be made with Approved Conditioners to condition and merchandise certified seed.

G. What does it cost to certify seed?

Certification fees for *soybeans and small grains* are $20.00 for the first acre and $1.10 for each additional acre. Certification tags are $.04 each.

There will be additional expenses for: (1) seed for planting, (2) removal of off-type plants, other crops and noxious weeds, (3) cleaning of planting, harvesting, conditioning, and conveying equipment, and storage facilities, (4) conditioning and bagging and (5) marketing.

The cost of producing, conditioning, and merchandising a bushel of certified soybean seed could vary from $1.50 to $3.00 or more.

H. How to apply for certification

You will need to obtain a copy of the current Certification Requirements which are available from the Association by April 15 each year.

You will need to also request the forms necessary to make application—the forms will vary from crop to crop.

You will then need to complete the forms and send them to the Association along with your certification fee and a certification tag taken from the seed bag container of each lot of seed for each field you plant.

I. Inspections and sampling procedures

A representative of the Association will inspect each field before harvesting. For small grains this would be anytime after planting. For soybeans this is usually after most or all of the leaves have fallen from the plant. *Fields harvested before inspection are not eligible for certification.*

A representative of the Association will sample the seed after a request for sampling has been received in the Association office. The sample will be checked for varietal purity and

identity, analyzed for mechanical purity (pure seed, weed seed, other crop seed, and inert material), and tested for germination.

J. Certification tags and seals

If all requirements have been met, certification tags will be issued. The certification tags will have the following information printed on them:

Variety and Crop
Lot Number
Grower Number

To meet requirements of State and Federal Seed Laws a tag showing the analysis of the seed must also be attached to each container.

Approved Seed Conditioners may print and attach certification tags to seed after conditioning but before sampling. (See Certification Requirements for the procedure.)

Certification tags must be sewn or stapled to each bag of seed so they cannot be removed without damage to the tag.

Seals are required when the standards of another country, province, or state require sealing of the seed container. When seals are required, the responsibility for meeting this need will be assumed by the seller of the seed. Seals must be purchased from the Association and are available at cost plus shipping and handling.

K. What is an approved conditioner of certified seed?

Conditioners having necessary equipment, storage facilities and trained personnel may become Approved Conditioners of certified seed. Applications to become an Approved Conditioner of certified seed are required annually. The plant is inspected each year for a charge of $75.00 the first year applying and $60.00 for each succeeding year. The conditioning year begins July 1 and ends June 30.

An Approved Conditioner may be approved to condition one or more crops, which include small grain, soybeans, grasses, legumes, or corn.

An Approved Conditioner may be approved to; recondition, rebag, and retag certified seed under a specific procedure developed for this purpose, assume responsibility for completing certification of the original applicant following field inspection, and may print and attach certification tags to conditioned seed previous to sampling. (See Certification Requirements for procedure.)

L. Unanswered questions

If you have other questions about the certification of seed, send them to the Iowa Crop Improvement Association, Agronomy Building, Iowa State University, Ames, Iowa 50011 or call 515/294-6921 or see the current requirements for certification.

Glossary

A

additive gene effect Gene action in which the effects on a genetic trait are altered by each additional allele.

alien addition line Line with an extra chromosome or chromosome pair from another species.

alien substitution line Line in which a chromosome or chromosome pair from a donor species replaces a chromosome or chromosome pair of a recipient species.

A line Line with cytoplasmic male sterility and nonrestorer nuclear alleles that is used as the female parent in a cross to produce hybrid seed.

allele Alternative form of a gene at a locus.

allopolyploid Individual that has two or more genomes from different species.

amphidiploid Tetraploid whose somatic cells contain the diploid chromosome complements of two parental species.

anaphase Stage of meiosis or mitosis at which chromosomes of a homologous pair or chromatids of a chromosome separate and move toward opposite poles of a dividing cell.

androgenesis Development of a haploid embryo from a sperm nucleus after it enters the embryo sac.

aneuploid An individual with other than an exact multiple of the haploid chromosome complement due to the absence or presence of part or all of one or more chromosomes.

anther Pollen-bearing portion of the stamen.

anthesis Process of pollen shed from the anthers.

antibiosis Antagonistic association in which one organism has an injurious effect on normal growth and development of another.

apomixis Production of seed from an unfertilized egg or from somatic cells of the maternal plant.

asexual reproduction Reproductive process that does not involve the union of gametes, and which results in individuals with a genotype identical to the maternal parent.

asynapsis Lack of pairing between homologous chromosomes during meiosis.
autogamy Development of seed by self-pollination.
autopolyploid Individual that has more than two complete chromosome sets of a single genome.
avirulent Parasite unable to infect and cause disease in a host plant.

B

backcross Mating of a hybrid to one of its parents.
BC_1, BC_2, etc. Symbols used to designate the first backcross generation, the second backcross generation, and so forth.
bias Departure of a statistic from its true value.
bivalent Configuration consisting of two homologous chromosomes that pair during meiosis.
blend *See* Multiline.
***B* line** Male-fertile maintainer line with normal cytoplasm and nonrestorer nuclear alleles that is used to produce seed of its male-sterile *A*-line counterpart.
breeder seed Seed or vegetative propagules of a cultivar, generally produced by the breeder, from which all subsequent generations of multiplication of the cultivar originate.
breeding Genetic modification of living organisms.
bulk method Method of managing a segregating population during inbreeding that involves growing the population in a bulk plot, harvesting the self-pollinated seed of plants in bulk, and using a sample of the bulk to plant the next generation.

C

centromere Region of the chromosome to which the spindle fiber attaches during meiosis and mitosis.
certified seed (a) Seed of a cultivar that has been verified for its genetic identity and purity by an official seed certifying agency. Classes of certified seed are foundation, registered, and certified. (b) Class of certified seed that generally is produced from a planting of registered seed, but which also may be produced from foundation or certified seed.
character Expression of genes as revealed in the phenotype of a plant.
chasmogamy Pollination and fertilization occur in an open flower.
chiasma Position on the chromosome at which it is assumed that crossing over occurs during meiosis.
chromatid One of two identical sister strands of a replicated chromosome held together by a centromere.
chromosome Structural unit in the nucleus that carries genes in a linear order.
cleistogamy Pollination and fertilization occur in an unopened flower.
clone Individual that is reproduced asexually to produce progeny genetically identical to itself.
colchicine Alkaloid extracted from seeds or corms of *Colchicine autumnale* that induces doubling of the chromosome number of cells by interfering with spindle fiber formation and separation of daughter chromosomes during mitosis and meiosis.
combining ability (a) General combining ability is the average performance of the progeny of an individual when mated with a genetically diverse population or series of genotypes. (b) Specific combining ability is the performance

of the progeny from the mating of two specific genotypes in relation to the average performance of progenies from the mating of a series of genotypes in all combinations.

composite Mixture of genotypes from several sources that is maintained in bulk from one generation to the next.

correlation Statistical measure of the degree to which two characters vary together.

coupling linkage Linked recessive alleles occur in one homologous chromosome and the dominant alleles at the same loci occur in the other chromosome, such as *ab/AB*.

covariance Statistical measure of the interrelationship between two variables.

crossing over Exchange of segments between chromatids of homologous chromosomes during meiosis.

cross-pollination Female gametes of an individual are fertilized by the male gametes of other individual(s).

cultivar Cultivated variety of a plant.

cytoplasm Protoplasm of a cell excluding the nucleus.

cytoplasmic inheritance Transmission of hereditary factors through the cytoplasm instead of through genes in the nucleus.

D

deficiency Absence or deletion of a segment of a chromosome.

degrees of freedom Number of independent comparisons that can be made in a set of data.

deoxyribonucleic acid (DNA) Linear polymer in the chromosomes that carries the genetic information of an organism, and which consists of purine and pyrimidine bases linked through deoxyribose by phosphate groups.

detassel Removal of the tassel (male inflorescence) of maize.

diakinesis Stage of prophase I of meiosis at which chromosome contraction is near its maximum.

diallel mating Mating a group of genotypes in all possible combinations.

dihybrid Progeny of cross between parents that differ for the alleles at two loci.

dioecious Staminate and pistillate flowers occur on different plants of the same species.

diploid Individual with two sets of a basic genome; (2x).

diplonema Stage of prophase I of meiosis when homologous chromosomes repel each other and the chiasmata formed by crossing over between chromatids of homologous chromosomes are first clearly visible.

disjunction Separation of homologous chromosomes during the first meiotic division and of chromatids during anaphase of the second meiotic division and of mitosis.

dominance Intraallelic interaction at a heterozygous locus when one allele partially or completely masks the expression of another allele.

dominant gene effects Gene action with deviations from an additive condition, such that the heterozygote is more like one parent than the other.

donor parent Parent in a backcross from which one or more genes controlling a desired characteristic are transferred to the recurrent parent.

double cross Mating of two single-cross hybrids.

duplex Condition in which a polyploid has two dominant alleles at a locus, such as *AAaa* in a tetraploid. Condition at a locus in a tetraploid when the same

allele occurs on two homologous chromosomes and a second allele occurs on the other two homologous chromosomes, such as *aabb*.

duplication Repetition of a segment of a chromosome.

E

early-generation testing Method of managing segregating populations in which the genetic potential of heterozygous and/or heterogeneous individuals, lines, or populations are evaluated at an early stage of inbreeding.

egg The female gamete. In plants, the egg is one of the nuclei in the embryo sac of the pistil that is formed after mitotic division of a megaspore.

emasculation Removal of the anthers from a flower.

embryo Rudimentary plant in a seed.

embryo sac Female gametophyte that arises from the megaspore by successive mitotic divisions.

endosperm Triploid tissue of the seed that arises from fusion of a sperm nucleus with the two polar nuclei of the embryo sac.

environment External conditions that influence expression of genes of an individual.

epiphytotic Sudden and usually widespread development of a destructive disease.

epistasis Interallelic interactions between two or more loci that control the expression of a character.

euploidy Variations in chromosome number that are multiples of complete sets basic to a species.

evolutionary breeding Breeding procedure in which a cultivar is developed from a heterogeneous population that is subjected to natural selection over a number of generations.

experimental error Variation in the measurement of a genotype or treatment that results from unrecognized or uncontrolled factors in an experiment.

F

F_1 First filial generation or hybrid obtained from the mating of two genotypes. The F_2, F_3, and later generations represent successive generations of self-pollination.

family Group of individuals directly related to a common ancestor.

fertility Ability to produce viable offspring.

fertility restoring genes Nuclear genes that act to restore fertility in plants with male-sterile cytoplasm.

fertilization Fusion of an egg and sperm to form a zygote.

foundation seed Class of certified seed produced from breeder seed.

full-sib family Progeny of the mating of two individuals.

G

gamete Sex cell produced by the female and male reproductive organs.

gene Basic unit of inheritance which is a sequence of DNA nucleotides that codes for a functional product of RNA or a polypeptide.

gene deployment Planned geographic distribution of major genes for specific resistance to pests for use in cultivar development and production.

gene frequency Proportion in which alternative alleles of a gene occur in a population.

gene interaction Modification of gene action by a nonallelic gene or genes.

gene pool Genes available for the improvement of a species that are present within the species or are derived from other species.

general resistance Host plant resistance that functions against all races of a pest.

genetic drift Changes in gene frequency in small populations due to random processes.

genetic equilibrium Condition of a population in which successive generations contain the same genotypic and gene frequencies.

genetic marker Allele used to identify a gene, chromosome segment, or a chromosome.

genome Basic set of chromosomes of an organism.

genotype Genetic makeup of an individual.

genotypic ratio Proportions of different genotypes in a population.

germplasm Total of the genotypes that constitute a species.

H

half-sib family Progeny that have one parent in common.

haploid Cell or individual with half (n) of the somatic chromosome number.

heredity Transmission of genetic characters from parents to progeny.

heritability Portion of the phenotypic variation among individuals that is due to genetic differences among them. Broad-sense heritability is estimated from the ratio of the total genetic variance to the phenotypic variance. Narrow-sense heritability is estimated from the ratio of the additive portion of the genetic variance to the phenotypic variance.

heterogeneous population Condition that exists in a population of individuals with different genotypes.

heteromorphic flower Bisexual flower in which the stamens and style attain different lengths.

heterosis Condition in which a hybrid exceeds the performance of its parents for one or more characters. Mid-parent heterosis represents performance of the hybrid that exceeds the average performance of the parents per se. High-parent heterosis occurs when the hybrid performance exceeds that of the best parent.

heterozygous Different alleles are present at a locus on homologous chromosomes in a diploid or polyploid individual, such as *Aa* in a diploid and *AAaa* in a tetraploid.

hexaploid Individual with six sets of chromosomes; (6x).

homoeologous chromosomes Homologous or partially homologous chromosomes originating from different genomes.

homogeneous population Condition that exists in a population of individuals with the same genotype.

homologous chromosomes Chromosomes that pair during prophase of meiosis.

homomorphic flower Bisexual flower in which the stamens and style attain comparable lengths.

homozygous Identical alleles are present at a locus on homologous chromosomes in a diploid or polyploid individual, such as *AA* in a diploid or *AAAA* in a tetraploid.

horizontal resistance *See* General resistance.

hybrid Progeny of the mating between genetically different parents.

hybridization Mating of genetically different individuals.

hybrid vigor *See* Heterosis.

I

ideotype Ideal plant model formulated to assist in achieving selection goals.

imperfect flower Flower that does not possess both a stamen and a pistil.

inbred line Line produced by inbreeding that is homozygous and homogeneous.

inbreeding Mating of individuals that are related by descent.

inbreeding coefficient Quantitative measure of the degree of inbreeding, commonly denoted by the letter F.

inbreeding depression Reduction in performance that is associated with an increase in homozygosity.

incompatibility *See* Self-incompatibility.

independent assortment Random distribution of chromosomes to the gametes during meiosis.

inversion Rearrangement of a chromosome segment so that its genes are in reversed linear order.

irradiation Exposure of organisms to X-rays or other types of radiation to increase mutation rates or change chromosome structure.

isochromosome Chromosome with two identical arms.

isogenic lines (isolines) Lines that are genetically similar except for the alleles at one locus.

isolation Separation of a population of plants from other genotypes with which they are capable of mating.

L

landrace Cultivated forms that evolved from a natural population of a plant species.

leptonema Stage of prophase I of meiosis at which chromosomes have a thin, threadlike appearance and chromatids cannot be distinguished.

line Progeny of an individual plant.

linkage Condition in which genes located on the same chromosome are inherited together due to their close proximity.

linkage value Frequency of recombination between linked genes due to crossing over.

locus Position occupied by a gene on a chromosome.

M

M_1 First generation after treatment with a mutagenic agent. The M_2, M_3, and later generations represent successive generations of self-pollination.

male sterility Condition in which pollen is absent or nonfunctional in flowering plants. Genetic male sterility results from the action of nuclear genes. Cytoplasmic-genetic male sterility involves the interaction of cytoplasmic factors and nuclear genes.

mass-pedigree Management of a segregating population during inbreeding by use of the bulk (mass) method when conditions are unfavorable for selection, and use of progeny testing (pedigree) when conditions are favorable for selection.

mass selection System of breeding in which seeds from individuals selected on the basis of phenotype are bulked and used to grow the next generation.

mating system Method by which individuals are paired for crossing.

mean Arithmetic average of a series of observations.

megaspore One of four haploid spores originating from meiotic divisions of the megaspore mother cell in the ovary. One of the four megaspores undergoes mitotic division(s) to form the embryo sac.

meiosis Process that occurs in the female and male reproductive organs by which the chromosome number in somatic cells (2n) is reduced by one-half (n) in the haploid gametes.

metaphase Stage of mitosis or meiosis at which the chromosomes or homologous chromosome pairs are arranged in a linear manner at the center of the cell, immediately before the chromatids or homologous chromosomes separate and pass to the two poles during anaphase.

microspore One of the four haploid spores originating from the meiotic division of the microspore mother cell in the anther and which gives rise to the pollen grain.

mitosis Process by which the nucleus of a cell is divided into two genetically identical nuclei.

modified single cross Progeny of a mating between two related inbred lines and an unrelated inbred line.

modifying genes Minor genes that influence the expression of a major gene.

monoecious Staminate and pistillate flowers borne separately on the same plant.

monohybrid Cross between parents that differ by the alleles at one locus.

monoploid Individual that has the basic (x) chromosome number.

monosomic Individual lacking one member of a chromosome pair; 2n − 1 chromosomes.

multiline Seed mixture of isolines, closely related lines, or unrelated lines.

multiple alleles More than two alternative forms of a gene that can occur at a locus; e.g., *A*1, *A*2, *A*3, and *A*4.

multivalent Associations formed by the pairing of more than two homologous chromosomes during meiosis.

mutation Heritable variation in a gene or in chromosome structure.

N

nonpreference Mechanism for insect resistance in which plant characteristics make an individual undesirable to insects as a site for food, shelter, or reproduction.

nonrecurrent parent *See* Donor parent.

nulliplex Condition in which a polyploid has the same recessive allele at a locus on all homologous chromosomes. Condition at a locus in a polyploid in which only one allele, regardless of its dominance, is present on all homologous chromosomes such as *aaaa*.

nullisomic Individual that lacks both members of the same chromosome pair; 2n − 2 chromosomes.

O

open-pollination Natural cross-pollination.

outcross A cross, usually natural, to a plant with a different genotype.

ovary Enlarged basal portion of the pistil, in which the seeds are borne.

overdominance Condition in which the performance of the heterozygote for a gene exceeds that of the homozygotes.

P

pachynema Stage of prophase I of meiosis when the two chromatids of each chromosome may be distinguishable and homologous chromosomes have completely paired.

parthenogenesis Development of an embryo from a sex cell without fertilization.

pathogen Organism capable of inciting a disease.

pedigree Record of the ancestry of an individual.

pedigree method Selection procedure in a segregating population during inbreeding that involves maintenance of the ancestry of genotypes as selection is carried out among plants and their progeny each generation.

perfect flower Flower possessing both a stamen and pistil.

phenotype Appearance of an individual or group of individuals.

phenotypic ratio Proportions of different phenotypes in a heterogeneous population.

pistil Seed-bearing organ in the flower, composed of the ovary, style, and stigma.

pistillate flower Flower bearing a pistil but not stamens.

plant introduction Seeds or vegetative propagules of plants that have been introduced from another country.

polar nuclei Two nuclei in the embryo sac of the pistil that unite with a sperm nucleus in triple fusion. In some species, the cell formed by triple fusion is the origin of the endosperm.

pollen grain Male gametophyte originating from a microspore.

pollination Transfer of pollen from the anther to the stigma of the pistil.

polycross Open-pollination of a group of selected genotypes in isolation that have been arranged in a manner that promotes random mating.

polyploid Individual with more than two basic sets of chromosomes in its somatic cells; triploid (3x), tetraploid (4x), and hexaploid (6x).

population Community of individuals with a common origin.

probability Likelihood that an event will or will not occur.

progeny test Test of the genotypic value of an individual based on the performance of its offspring.

prophase Stage of meiosis or mitosis during which chromosomes coil and contract and during which homologous chromosomes synapse in meiosis.

protandry Maturation of the anthers before the pistil.

protogyny Maturation of the pistil before the anthers.

pseudogamy Absolute requirement for pollination to obtain viable apomictic seed, even though the sperm and egg nuclei do not unite.

pure line Homogeneous progeny of a homozygous individual.

pyramiding Incorporation of two or more major genes for specific resistance to a pest into a cultivar.

Q

quadriplex Condition in which a polyploid has four dominant alleles for a given locus, such as *AAAA* in a tetraploid.

qualitative character Character for which the phenotypic variation among genotypes is not continuous and can be separated into discrete classes.

quantitative character Character for which the phenotypic variation among genotypes is continuous and cannot be separated into discrete classes.

R

***R* line** Pollen parent line, containing fertility restoring alleles, that is crossed with an *A* line in the production of hybrid seed.

random Occurs by chance without any restrictions.

randomization Process of randomly arranging genotypes or other treatments in an experiment.

recessive Condition of an allele whose expression is masked in the presence of a dominant allele at the same locus on a homologous chromosome.

reciprocal cross Mating of two individuals in which each is used as the male parent in one cross and the female parent in the other.

recombination Formation of new combinations of genes as a result of the independent assortment that occurs in a heterozygous individual during meiosis.

recurrent parent Parent to which successive backcrosses are made in a backcross breeding program.

recurrent selection Cyclic selection in a breeding population to improve the frequency of desirable alleles for a character.

registered seed Class of certified seed generally produced from foundation seed, but which may also be produced from breeder seed.

regression Statistical measure of the rate of change in one variable as the level of the other variable is changed.

repulsion linkage Linkage between two heterozygous loci in which a dominant allele at one locus is on the same chromosome as a recessive allele at the other locus, such as *aB*:*Ab*.

resistant Characteristic of a plant that is capable of suppressing or retarding development of a pathogen or other injurious factor.

roguing Removal of individuals that do not conform to the standard of other members of a cultivar or population.

S

S Symbol used to denote generations of self-pollination. In this book, the S_0 and F_2 generations are considered genetically equivalent; therefore, the $S_1 = F_3$ and the $S_2 = F_4$.

sample Finite series of individuals or observations taken from a population.

segregation Separation of allelic pairs and their distribution to different cells during meiosis.

selection Identification of individuals or lines that are more desirable than others in a heterogeneous population.

selection differential Difference between the mean performance of genotypes selected from a population and the overall population mean.

self-fertility Capability of producing seed with self-pollination.

self-incompatibility Inability of male gametes to effect fertilization of female gametes from the same individual.

self-pollination Process by which male and female gametes from the same individual unite to produce seed.

semigamy Reproductive process in which the sperm nucleus enters the egg cell, but does not fuse with the egg nucleus.

sexual reproduction Reproduction that involves the fusion of male and female gametes.

sib mating Mating of individuals within the same family or line.

simplex Condition in which a polyploid has one dominant allele for a locus on homologous chromosomes, such as *Aaaa* for a tetraploid. Condition at a locus in a tetraploid when the same allele occurs on three homologous chromosomes and another allele occurs on the other chromosome, such as *aaab*.

single cross Mating between two genetically different parents.

single-seed descent Breeding procedure used during the inbreeding of a segregating population in which plants are advanced by single seeds from one generation to the next.

species Unit of taxonomic classification into which genera are divided. Groups of actually or potentially interbreeding natural populations that are reproductively isolated from other such groups.

specific resistance Host plant is resistant to specific races of a pest.

sperm nuclei The male gamete. In plants, two sperm nuclei are formed by mitotic division of the generative nucleus of a microspore. One sperm nucleus unites with the egg cell to form the zygote that is the origin of the embryo, and the other unites with the two polar nuclei in triple fusion, which is the origin of the endosperm in some plant species.

stability, genotypic Reliability of performance of a genotype or group of genotypes across different environmental conditions.

stamen Pollen-bearing organ in the flower composed of an anther and a filament.

staminate flower Flower bearing stamens but not a pistil.

strain A group of similar and related individuals.

susceptible Characteristic of a host plant such that it is incapable of suppressing or retarding a pathogen or other injurious factor.

Syn Symbol used to designate generations of propagation of a synthetic population. The Syn 0 represents the parent clones or lines, Syn 1 is the progeny of the first intermating of the parents, Syn 2 is the open-pollinated progeny of the Syn 1 generation.

synapsis Pairing of homologous chromosomes during prophase I of meiosis.

synthetic Population produced by intermating selected genotypes and which is produced from one generation to the next by open-pollination.

T

telocentric chromosome Chromosome consisting of a single arm with a terminal centromere.

telophase Stage of meiosis or mitosis when the chromatids or chromosomes have reached the poles of the cell following anaphase and changes in the contraction of the chromatids and chromosomes occur.

testcross Mating used to evaluate the genotype of an individual.

tetragenic Condition at a locus in a tetraploid when four different alleles occur on homologous chromosomes, such as *abcd*.

tetraploid Individual with four basic (x) sets of chromosomes.

three-way cross Progeny of the mating of three genetically different parents.

tolerance Ability of plants to perform well in the presence of a destructive pathogen, insect, nematode, or environmental condition.

topcross Type of testcross that involves the mating of a series of individuals to a common parent to produce half-sib families for evaluation.

transgressive segregation Occurrence of one or more individuals in a population whose performance for a character falls outside the range of the parents of the population.

translocation Change in the position of a segment of a chromosome to another location in the same or a different chromosome.

trigenic Condition at a locus in a tetraploid when the same allele occurs on two homologous chromosomes and two different alleles occur on the other chromosomes, such as *aabc*.

triplex Condition in which a polyploid has three dominant alleles for a locus on homologous chromosomes, such as *AAAa* in a tetraploid.

triploid Individual with three basic (x) sets of chromosomes.

trisomic Individual that has the diploid chromosome complement and one chromosome of the genome in triplicate; 2n + 1 chromosomes.

U

univalent Unpaired chromosome in meiosis.

V

variance Statistical measure of the mean squared deviation of individual measurements from the overall mean of the measurements.

variation Differences among individuals due to differences in their genetic constitution, their response to the environment, genotype × environment interaction, and experimental error.

variety Subdivision of a species for taxonomic classification. Used interchangeably with the term cultivar to denote a group of individuals that are distinct genetically from other groups of individuals in the species.

vertical resistance *See* Specific resistance.

virulence Capacity of a pathogen to cause a disease.

Z

zygote Cell formed by the union of female and male gametes.

zygonema Stage of prophase I of meiosis when the threadlike chromosomes pair.

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