Corn (Zea mays L.) is an annual crop indigenous to the Western Hemisphere. Columbus encountered corn on his first voyage in 1492, and subsequent explorers found corn being grown by the Indians throughout the Western Hemisphere. It now is grown in every state of the United States and in every important agricultural area of the world. It is grown on more than 120 million ha in the world, and is an important commodity in world trade. Corn is consumed either directly or indirectly by millions of people. About 75% of the corn is fed to animals; thus, indirect consumption is greater than direct consumption. Corn is produced primarily as an energy crop, but specialized versions for protein, oil, waxy, sweet corn, and popcorn are available.

I. PARENTAL MATERIAL

Corn is an extremely variable species that is included in the grass family. Corn and seven other genera are commonly included in the family Maydeae, three (Zea, Euchlaena, and Tripsacum) that are native to the Americas, and five (Coix, Chionachne, Polytoca, Scherachne and Triobachne) that are native to southeastern Asia and Australia. Some taxonomists include teosinte (Euchlaena mexicana) in the same genus as corn (Zea). Euchlaena and Tripsacum are considered the closest relatives of corn. The genera from southeastern Asia and Australia have not been studied extensively and are not considered seriously as relatives of corn.

Intergeneric crosses of Zea (corn) have been successful with Euchlaena (teosinte), Tripsacum, Saccharum (sugarcane), and Coix (Goodman, 1965).
Corn and teosinte are easily crossed, have similar chromosomes, and produce fertile offspring. Special techniques usually are required to cross corn and Tripsacum, and the hybrids are male-sterile, even after several backcrosses to corn. Corn and sugarcane have been crossed several times, but the hybrid progeny have never attained the reproductive stage. Only one case of a corn-Cox hybridization has been reported, and the seeds of the cross were not viable.

Corn is grown from 58° N Lat to 40° S Lat, from below sea level of the Caspian plains up to 3,000 m in the Andes Mountains, and from semiarid regions having 25 cm annual rainfall to tropical regions that receive more than 500 cm annual rainfall. Consequently, collections of corn cultivars have an extraordinary diversity of morphological and physiological traits. In the Western Hemisphere alone, there are some 25,000 collections of corn that make up about 130 distinct races. In the United States, however, more than 90% of the breeding effort is directed to germplasm whose origin traces to not more than three of the 130 existing races (Brown, 1975). Extensive collections of the different cultivars, types, and races are available at Centro Internacional de Mejoramiento de Maíz Y Trigo (CIMMYT), Chapingo, Mexico; the National Seed Storage Laboratory, Fort Collins, Colo.; and the North Central Regional Plant Introduction Center, Ames, Iowa.

II. PLANT CULTURE

A. Field

The relationship between corn culture and climatic conditions was reviewed by Shaw (1977), and an excellent discussion of corn production was given by Larson and Hanway (1977). The purpose of this section will be to consider items that are specific to breeding nurseries.

Good plant stands and vigorous plant growth are necessary in the breeding nursery. A good seedbed is required for inbred materials because of their reduced seedling vigor. Fungicide seed treatment should be used, except in instances in which selection for resistance to soil-borne pathogens is intended. Seed germination requires a soil temperature above 10°C; consequently, the date of planting should be determined by expected temperatures.

Regular fertility practices for the soil type should be used. Plant densities will vary, depending upon specific requirements (Section IV, D). Overplanting and thinning to a certain plant density may be desirable in some instances. Weed control for the whole season is important, particularly in nurseries of inbred lines because these less-vigorous materials do not compete strongly with many weed species. Chemical control of leaf diseases and insects may be necessary in some seasons. Pest control is required in most areas where winter nurseries are grown.

Special environmental conditions for hybridization or self pollination of corn are not required when it is grown in its area of adaptation. Temperature is usually not an important problem, unless it is excessively
high when pollen is released. Pollen grains will lose viability very rapidly when the temperature exceeds about 30°C, particularly if the relative humidity is low. Deficient soil moisture at flowering usually causes a delay in silk emergence relative to tassel development, and the silk may cease growth before it has emerged from the ear husk. Moisture stress also may cause tassel firing and, thus, abortion of the male flowers. Even in areas where rainfall usually is adequate for good corn production, supplemental irrigation in breeding nurseries can be advantageous just before or during silking in most years. The effect of a soil-moisture stress varies among genotypes and usually is observed on inbred lines sooner than on single crosses (Tatum and Kehr, 1951).

B. Growth Chamber and Greenhouse

Corn plants do not grow well in the greenhouse during the winter months. The primary problems seem to be day length and light level. Supplemental lighting must be used, but plants will be considerably less vigorous than in the field. Greenhouse culture can be used for special purposes if the number of plants needed may be relatively few; otherwise, winter nurseries in the warmer climates of the low latitudes should be used.

III. FLORAL CHARACTERISTICS

The corn plant is monoecious, with the male flowers in the tassel and the female flowers on the ear shoots (Fig. 1). When the male flower is mature, the anthers are exserted from the spikelet, and pollen is dispersed through a pore at the tip of the anther. Anther exsertion usually begins on the central spike a short distance below the tip. Each spikelet has two flowers, and the anthers are exserted from the upper flower first and then from the lower flower, either later the same day or the following days. When the anther pore opens, the pollen may be completely dispersed in only

Fig. 1—Corn stages. A) Tassel with anthers exserted; B) ear shoot with silks emerged.
a few minutes, or over a longer period as determined by the temperature, humidity, air movement, and genotype. Pollen shed for a tassel may vary from only 1 or 2 days to more than a week.

Pollen is dispersed by wind currents; consequently, extensive cross pollination and little self pollination occurs on an individual-plant basis. Insects cause an insignificant amount of pollen dispersal, but they can cause contamination in controlled self- or cross-pollinations. The amount of pollen dispersed from one tassel will vary among materials. Hybrids will shed more pollen for a longer period than will inbred lines. Kiesselbach (1949) reported estimates that 25,000 pollen grains are produced for each silk on an ordinary ear. With average summer temperature and humidity in the U.S. Corn Belt, dispersal may begin about 3 hours after sunrise and continue for 1 to 3 hours. With cooler temperature and higher humidity, however, dispersal may be delayed until midday and continue most of the afternoon. Once pollen is dispersed into the atmosphere, it will remain visible only a few minutes because of rapid desiccation.

The top ear shoot usually is at the sixth or seventh node below the tassel in U.S. Corn Belt germplasm. There is an axillary bud at each node below the top ear node, but elongation of the cob and silk emergence usually occur at only the upper 2 or 3 nodes. The silks that emerge from the tip of the ear husk are the functional stigmas, and there is one silk for each potential kernel (Fig. 1B). The first silks to emerge usually are from near the basal part of the ear. The rate of silk emergence is controlled by temperature, soil moisture, and soil nutrients; consequently, complete emergence may occur in only 2 or 3 days under favorable growth conditions or may require 5 to 7 days with cool temperatures. Under extreme stress conditions, silk growth may cease completely. Silks usually emerge first from the top ear node and may be followed in a few hours or days by silks from the second ear node and, sometimes, a third.

The silks usually emerge at the top ear node 1 to 3 days after anther dehiscence has begun. Tassel development seems to control development of the ear shoot, and this dominance is greatest for genotypes that produce only one ear per plant in any environment. Prolific genotypes may have no dominance for the tassel, and their silks frequently emerge before the tassel begins to shed pollen.

The pollen grain has a relatively thin outer membrane that gives little environmental protection; consequently, viability may be lost in a few minutes because of desiccation. Everett (1958) found that the best storage temperatures were −7 to +4 C. Storage temperatures near 0 C permitted retention of viability in some pollen grains for as long as 190 to 200 hours after collection. Storage in a beaker at 4 C and 90% relative humidity gave effective pollen up to 6 days (Jones and Newell, 1948). Storage of cut tassels with cut ends in water gave effective pollen up to 9 days. Pfahler (1967) found that a storage period of 1 day at 5 C did not show much change in fertilization ability of pollen grains. Water content of corn pollen had a decisive effect on its storability in liquid nitrogen (Barnabas and Rajki, 1976). The critical moisture content seemed to be about 30% in their study, with a greater content contributing to loss of pollen viability in storage. They observed that pollen with a moisture content of 22.2% and stored in liquid nitrogen at −196 C for 365 days resulted in high seed set.
Silks become receptive as soon as emerging from the ear husk. The length of time for receptive silks on an ear is determined by the time required for all silks to emerge from the husk and the time a silk remains receptive after emergence. Data indicate that it may require up to 5 to 6 days for all silks to emerge from an ear (Everett, 1958; Hallauer and Sears, 1966). Receptivity up to 10 days after emergence has been reported (Walden and Everett, 1961), but it falls off rapidly after that. High temperatures and low humidities probably would decrease this time. Best seed sets occurred with pollinations 3 to 5 days after first silk emergence, but pollinations after 8 days still gave 66% seed set compared with the optimum (Hallauer and Sears, 1966).

IV. ARTIFICIAL HYBRIDIZATION AND SELF-POLLINATION

A. Equipment

Items of equipment required include tassel bags, ear shoot bags, paper clips or a stapler, a knife, a pencil, tags, and an apron (Fig. 2A). The breeder has a choice of several types, sizes, and weights of tassel and ear shoot bags. The bags must be water repellent and made with moisture-proof glue. Paper clips must be slip-proof. Brass-plated clips are best because they rust quickly and will not slip. Small hand staplers may be used instead of paper clips. The knife commonly used is a paring knife of convenient size that must have a sharp blade. Graphite marking pencils are useful for labeling, and the lead should be soft enough to give a good mark on the tassel bag. Tags used for labeling preferably should have metal eyelets. Aprons should have one large pocket to carry up to 100 tassel bags and 3 or 4 smaller pockets to carry ear shoot bags and other pieces of equipment.

B. Preparation of the Female

The ear shoot (husk tip) must be covered by an ear shoot bag before the silks emerge from the husk tip (Fig. 2B). Ear shoots may be covered any time during the day, but it frequently is the first operation of the day because it can be done before pollen shedding begins. The length of ear shoot development from the leaf axil before silks begin to emerge will vary considerably among genotypes and also is affected by environmental conditions. Once ear shoots begin to emerge, the nursery should be checked daily, particularly if temperatures are moderate and soil moisture is adequate to cause rapid growth. The bag should be placed so that it is firmly anchored between the shoot and the auricle of the ear leaf, or sometimes it is expedient to break off the ear leaf and pull the bag down so that it is anchored between the shoot and the stalk (Fig. 2C).

The best ear shoots to use in self or cross-pollination will have had silks emerged under the shoot bag for 2 to 3 days. If a covered shoot has silks emerged more than 2 or 3 days before it can be used, it may be necessary to trim the silks to prevent them growing out of the bag and becoming con-
Fig. 2—Pollination of corn. A) Equipment used for self- and cross pollination; B) bag being placed on ear shoot before silks have emerged; C) ear shoot bag in place before pollination; D) tassel covered by bag the day before hand pollination; E) ear shoot bag lifted to permit pollination; F) tassel bag clipped in place over pollinated ear.
taminated. On the day preceding intended pollination, the extended silks are cut to within 2 cm of the husk tip. This procedure will cause the formation of a brush of silks on which the pollen can be spread the next day (Walden, 1967). If it is necessary to use the ear before all silks have emerged, it may be convenient to cut the ear shoot to within 2 cm of the cob tip so that all silks will be available the next day. Silks trimmed this way usually will grow 2 to 4 cm before being pollinated the next day. The shoot bag must be replaced securely after preparation of the shoot.

C. Pollination

A tassel usually produces its greatest volume of pollen in the second and third days of dehiscence. When the ear is prepared for pollination, the tassel that is the intended source of pollen is covered by a tassel bag the same day (Fig. 2D). The tassel should have at least 1 day of anther exsertion and pollen dehiscence. The tassel bag is placed over the tassel on the day before pollination to eliminate contamination by other pollen that may adhere to the tassel, and it will hold all pollen shed by the tassel while the bag is in place. The bag is held in place by a paper clip or a staple.

Pollen may be collected and used immediately from uncovered tassels that are dehiscing. This procedure may be convenient in a cross-pollination program in which several ears are pollinated by pollen from one tassel or a pollen composite from several tassels. There may be some contamination from tassel to tassel because of wind-blown pollen, but contamination will usually be low because the amount of pollen collected is much greater than the amount of foreign pollen. The technique is satisfactory if a low frequency of contamination can be tolerated; otherwise, it should not be used (Genter, 1976).

For self-pollination, the pollen is taken from the tassel and placed on the silks of the same plant. With reasonable care, contamination will be infrequent because of the excessive amount of pollen grains from the intended source in proportion to foreign pollen.

For cross-pollination, pollen from one tassel is used for one or several ear shoots simply by pouring pollen from the pollen bag directly onto the silks of another plant. Where several pollinations are made and pollen from several tassels is composited, a pollen gun may be used. Clumping of the pollen may occur, particularly if the humidity is high, and it usually is necessary to have a humidity-control compound in the gun to keep the pollen dry.

The pollinating operation must wait until anthers are exserted and pollen is released. This may be about 3 hours after sunrise, but it may be earlier or later in the day, depending upon the temperature and humidity. Pollen dehiscence under the bag will not be complete, however, and shaking the tassel in the bag will give viable pollen most of the day. Controlled pollinations made at 2-hour intervals from 0900 to 1700 hours gave no significant differences in amount of seed set (Hallauer and Sears, 1966). Walden and Everett (1961) found that the optimum time for pollinations ranged from 1530 to 1930 hours.
The silk is exposed for pollination either by lifting the ear shoot bag or by tearing off the closed end of the bag (Fig. 2E). After the pollen has been dusted onto the silk, the tassel bag is quickly placed over the ear shoot, pulled down toward the ear node, and fastened around the stalk either by a nonslip paper clip or staple (Fig. 2F). If the ear shoot bag is left in place after pollination, it may prevent contamination that might be caused by insects, such as grasshoppers (*Melanoplus* spp.) that may chew holes in the tassel bag. Conversely, in some seasons when the ear shoot bag is left in place, it may cause considerable ear-tip rot by harvest time.

When more than one ear on a plant is pollinated, seed set on the lowest ear is most reliable if pollinated 1 day before the ear at a higher node.

Marking on the tassel bag may be necessary to identify parental materials. For this purpose, a moderately soft graphite marking pencil is used. Limited marking is desirable because it is time-consuming. Different-colored, striped tassel bags are available, and in some instances, a color can be used for identification. The pollination date can be marked on the bag the day ahead of pollination by using a date stamp and pad with weatherproof ink. Large numbers or letters should be used when marking on the bag because it may be partly torn before the ear is harvested.

One usually can expect good success from hand pollination with corn. In a drought situation, scarcity of viable pollen for a pollination may reduce seed set and some contamination may occur. Seed set often may be obtained for only half to two-thirds of the ear if pollinations are made 1 to 2 days either too early or too late.

### D. Factors Affecting Efficiency

Items that should be considered in planning the field layout of a breeding nursery are hand vs. machine planting, dates of planting, maturities of breeding stocks, breeding procedures, plot sizes, and plant densities. Variable planting dates may be desirable to spread out the work load in the pollination and harvest seasons. Dates of planting should be planned so that physiological maturity will be attained and seed ears can be harvested before damaging frost is expected.

Proper planning of the field layout will enhance the efficiency of a breeding procedure. There usually are selfing nurseries for inbred line maintenance, inbred line increase, and inbred line selection and inbreeding; crossing nurseries for single crosses, three-way crosses, double crosses, and top-crosses; and recurrent selection nurseries. The plot size should be standardized as much as possible.

If one needs a large supply of seed, as in the increase of an inbred line or in the production of a series of single crosses, a relatively low plant density of about 30,000 plants/ha is desirable. One usually obtains the maximum number of seeds per pollination at low plant densities. A higher density, such as 60,000 plants/ha, is used if the purpose is to sample a large number of plants in a heterogeneous cultivar. Higher densities of 60,000 to 70,000 plants/ha should be used in an inbred line selection nursery to facilitate the identification of lines that tolerate stress conditions. If the selection
is for prolificacy, a lower density of 30,000 to 40,000 plants/ha may be desirable to permit the individual plant to express its potential for developing more than one ear per plant.

To determine the number of plants to be used per progeny in an inbred selection nursery, one must consider that genetic variation among progenies increases and, within progenies, decreases as inbreeding progresses. Therefore, the opportunity for effective selection within a progeny decreases rapidly as the coefficient of inbreeding increases.

Rows in the breeding nursery are arranged in ranges or tiers, with alleys or walkways separating the ranges. The number of rows per range should be limited to not more than 60 to 70 whenever possible. Duplication of plot numbers in field labeling should be avoided, even in different areas of the nursery, because it may cause problems in seed identification.

For the production of crosses, parents should be planted in paired rows. A string tied loosely at ground level between paired rows is recommended to minimize the risk of crossing between the wrong rows. If several crosses have one parent in common, the common parent is used as male and is planted adjacent to a block of the female parents. These planting arrangements eliminate the necessity of labeling bags after pollination. The flowering dates of two parents frequently do not match, thus necessitating a delayed planting for the earlier-flowering parent. The actual number of days to delay planting for the earlier line may be based on accumulation of growing-degree days after the later parent is planted (Chapter 1). The row for the delayed planting may be obliterated by rain, but it can be marked by planting a few field peas (*Pisum sativum*) on the first date of planting.

An applied breeding program will usually have evaluations of new lines in topcrosses or testcrosses in which there is a common tester parent. It may be most convenient to produce seed of these crosses in an isolated crossing block in which the common tester is the male and the other lines are detasseled and serve as females.

Recurrent selection programs that include crossing selected plants to a tester should have a field design that makes pollination as convenient as possible. The selection and tester populations are planted in adjacent blocks, such as across an alley in two ranges, to minimize walking distance between the two blocks. If flowering of the two populations does not coincide, two dates of planting for one or both will be needed. Even if the two populations do coincide for the flowering date, it is advantageous to plant the female parent a few days earlier than the male so that the silks are fully emerged before pollination begins. Virtually full seed set can be expected if the silks emerge 7 days before pollen shed (Walden and Everett, 1961).

Some mechanical procedures may be used to delay flowering because the growing point has not progressed above the ground even though the seedling has reached the four- to six-leaf stage. Flaming treatments on inbred lines when the plants were 5 cm tall and a second flaming when the plants were again 5 cm tall delayed anthesis 2.2 to 2.6 days and silking 2.3 to 2.8 days (Green, 1949). He observed an average reduction in grain yield of 7%.

Dungan and Gausman (1951), using clipping treatments on eight single crosses, obtained an average pollen-shed delay of 8.1 days when plants 87 cm tall were clipped to 6 cm. They observed an average silk delay of 10.8
days and a yield reduction of 47.6%. Clipping plants 40 cm tall back to
ground level caused delays of 5.3 days for pollen shed and 6.1 days for silk
emergence, and a 17.7% yield reduction in their study. The most practical
treatment for eight inbred lines was clipping to ground level when the plants
were 31 cm tall. Such a treatment caused a 4.6-day delay for pollen de-
hiscence, a 5.6-day delay in silk emergence, and a 23.2% yield reduction.

Cloninger et al. (1974) obtained an average pollen-shed delay of 5.5
days with a clipping treatment at the 4-leaf stage, 7.6 days at the 6-leaf
stage, and 6.7 days at the eight-leaf stage for 28 single crosses among eight
inbred lines. No data were given for silk emergence. They observed an
average yield reduction of 11% for clipping at the four-leaf stage, 38% for
the six-leaf stage, and 46% for the eight-leaf stage.

Many corn strains are sensitive to photoperiod; consequently, time to
flowering for both male and female flowers may be changed by altering the
day length. Low-latitude corn strains, for example, are short-day sensitive
and, when grown in a higher latitude, will not develop to anthesis until late
summer when the day length decreases. By creating an extension of the
night by artificial means, low-latitude strains can be forced to anthesis
earlier in the summer.

Genetic markers are not used extensively in corn breeding, except for
some special genetic studies or specific traits. One of the first com-
prehensive cataloging of corn mutants was by Emerson et al. (1935). A de-
tailed list of the corn mutants, the 10 chromosome maps, and colored
prints for many of the plant and seed mutants was published by Neuffer et
al. (1968).

Seed and seedling markers can be used for the production of homozy-
gous diploids from monoploids (Chase, 1947; Chase, 1952; Goodsell, 1961;
Nanda and Chase, 1966; Kermicle, 1969). The most widely used endosperm
marker is sugary-1 (su1), which is responsible for the endosperm type of
most commercial and garden sweet corn. Other endosperm mutants that are
being used commercially in hybrids or have been studied for possible use in
speciality types include waxy, opaque-2, floury-1 and -2, sugary-2, dull,
amylose extender, shrunken-2, and brittle-1. Some plant mutants that have
been studied for their usefulness in hybrid cultivars include brown midrib,
brachytic-2, reduced, compact, gametophyte factors, liguleless, male
sterile, and tassel seed.

V. NATURAL HYBRIDIZATION

Natural hybridization of corn by wind pollination is used to advantage
in breeding procedures and hybrid seed production (Chapter 8). Seed in-
creases of synthetic cultivars can be made with appropriate isolation from
other corn. Certification standards require that a cultivar must be located
not less than 200 m from corn of a different color or texture. The isolation
may tend to be more stringent in a genetic experiment in which no contami-
nation can be tolerated. Raynor et al. (1972) and Paterniani and Storr
(1974) showed less than 1% effective pollination for a relatively short
distance from the contaminating source. Hutchcroft (1959) found in 1 year
that contamination exceeding the 1% certification requirement was limited
to a subplot of $3 \times 3$ m surrounding the contaminating plant. Sometimes natural barriers, such as trees or dates of planting, can be used to effect isolation.

VI. SEED DEVELOPMENT, HARVEST, AND STORAGE

The mature corn kernel almost invariably contains four roots, the radicle, and three seminal roots. In many hybrids and most inbreds, all these parts have been initiated before the 30th day after pollination (Sass, 1977). Maximum dry weight of the kernel, defined as physiological maturity, is not attained for at least an additional 25 to 30 days (Hillson and Penny, 1965; Hallauer and Russell, 1962). Sprague (1936) found that seed harvested 21 days after pollination and permitted to dry slowly to 16% moisture, germinated 100% in 6 days. Experience has shown, however, that harvest before 50 days after pollination may affect germination, particularly in cold soil, and frequently affects seedling vigor.

If several ears are harvested from the plot or row of a progeny and individual ear identification is not needed, all ears can be placed in a mesh bag, closed with a wire tag, and marked according to plot or row number. If individual ear labeling is necessary, a marked tag can be attached to the ear either by a short nail or rubber band. Tags should be marked as simply as possible to save time and to avoid labeling errors.

Breeding stocks usually will need to be dried before they can be stored. For artificial drying, temperatures are much more critical for immature seed with high moisture content than for mature seed in which the moisture content at harvest is less than 30%. The critical level for immature seed seems to be 40 C (Harrison and Wright, 1929; Wileman and Ullstrup, 1945). Temperatures up to 15 degrees higher can be used safely for seed with less than 30% moisture, provided that air circulation is sufficiently rapid (Wileman and Ullstrup, 1945; McRostie, 1949; Dimmock, 1947). The generally recommended drying temperature is 40 to 43 C (Kiesselbach, 1939; Dimmock, 1947), and seed should be dried to 12 to 13% moisture. Further drying to moisture content as low as 5% is not injurious to the seed.

Shellers, operated either by hand or motor, are available for shelling single ears or lots of ears. Large machines equipped to remove chaff and that can be used to shell single ears or large bulk lots are useful in a large program. All shelling equipment must be self cleaning to avoid mixing among samples. Shelling should be done by hand for studies in which sheller damage cannot be tolerated.

All seed samples should be labeled with the year in which they were produced, and, in some instances, the location will be needed also. For most samples, a field row or plot number will be the only identification needed, and, if the sample is derived from a single-plant selection, a plant number will be used also. For other samples, a pedigree will be needed. Detailed labeling on seed packets should be avoided because it is an easy source of errors.

Two kinds of storage facilities are required, short term and long term. The seed laboratory probably will be satisfactory short-term storage for many items that are grown every year. Bockholt et al. (1969) obtained
germination of 80% after 2 years, but only 17% after 3 years, when seed was stored in the laboratory in paper envelopes. When they stored seed dried to 9.5% moisture at room temperature in a sealed container, germination was 66% after 5 years and zero at 11 years.

Long-term storage facilities with controlled temperature and humidity are necessary for seed lots of materials that do not need to be grown every year. Research has indicated that the seed should be dried to 11% or lower before being placed in storage (Sayre, 1948; Goodsell et al., 1955; Bockholt et al., 1969). Storage in sealed containers will increase longevity of the seed. Storage in sealed containers with carbon dioxide or nitrogen showed no advantage in maintaining seed quality (Sayre, 1948; Goodsell et al., 1955).

A rule of thumb for corn seed storage is to maintain a temperature (C) and humidity so that the sum of the two values does not exceed 60. At Iowa State University, seed is stored at approximately 10 C and 45 to 50% relative humidity, and satisfactory germination has been retained up to 20 years on some samples. It must be recognized, however, that seed of some genotypes will not germinate after 15 years. Longer term storage can be obtained by using lower temperature and humidity, but this requires more elaborate equipment.

REFERENCES


