after at least five successive generations of controlled self-pollination, following selection from suitable but diverse open-pollinated varieties, composites, synthetics, or multiple crosses. After developing inbred lines with consistent desirable characters, the maize breeder evaluates them in various hybrid combinations in yield trials.

Production of single-cross seed. Single-cross seed is the first generation (F_1) which is produced by the controlled crossing of two inbred lines. The male and female are selected on the basis of their superior combining ability, vigour, height, flowering period, pollen-producing capacity, ear placement, and yield. It is desirable that the male parent be taller and a good pollen producer, while the female parent should be vigorous and high-yielding. If the male is designated as 'A' and the female as 'B', then the single-cross is designated as 'A × B'.

Single-cross seed may be used as (a) certified seed, or (b) parent components for the production of certified seed of three-way and double crosses.

Production of three-way cross seed. Three-way cross seed (hybrid seed) is produced when a single cross (A × B) is crossed with another inbred line C. The A × B should be used as female and the C as male, provided it is a good pollen producer which synchronizes with silking of the female. The single-cross seed (female parent = A × B) is planted in six rows while the male parent (inbred line = C) is planted in two rows (Fig. 6.3.). Produce from the detasseled female parent is commercial seed of a three-way cross.

Double-cross seed production. The production of certified seed of double-cross hybrids is based on crossing two single-cross hybrids, one of which serves as seed parent (♀) and the other as pollen parent (♂). These parents are selected on the basis of their combining ability and coincidence of flowering period, height, pollen-producing capacity, and yield. This method has certain advantages: (1) minimum risk involved; (2) high yield of seed per unit area; and (3) lowest production costs.

In this method the male:female ratio should be 1:3 or 2:6, or 2:8. The other procedures and requirements are the same as for single-cross seed production, i.e.:

- Satisfactory isolation.
- Timely removal of off-type and doubtful plants, with both the parents.
- Regular detasseling of the female parent before pollination.
- Inspection of the crop during the growing season and roguing of diseased plants before pollination.

Seed production of open-pollinated varieties (local and introduced), synthetics, and composites is carried out with the idea of maintaining most of the characters for which these varieties are grown for as long as possible. For each such variety, true-to-type ears are selected in the field. These ears are shelled and the seed is divided into two groups. Seed from the two

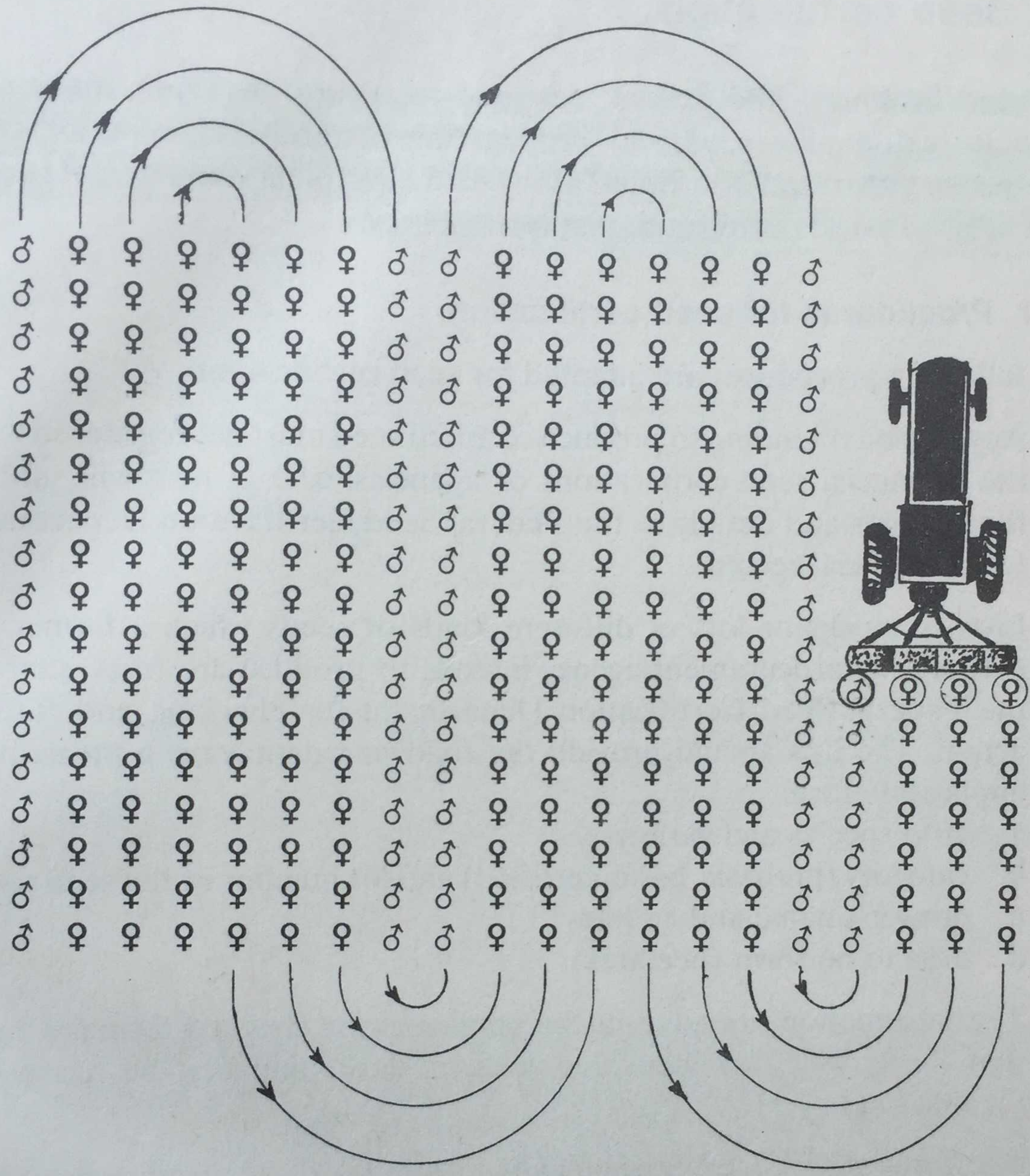

Figure 6.3 Example of 6:2 ratio of seed-parent to pollen-parent rows. After Feistritzer (1982:67).

groups is planted in alternate rows. Fifty of the plants are detasseled before pollination, preferably all the plants in every second row, and only the detasseled rows are harvested for seed.

During the process, all the necessary steps for the production of certified seed (prebasic or basic seed) are taken, i.e. isolation of plots (250 m), and roguing of diseased, off-type and low-yielding ears. The bulk of this seed is prebasic seed and must be used in seed production programmes.

6.5 Seed certification

Seed certification is the process designed to secure, maintain, and make available high-quality seed and propagating materials of superior crop varieties, so grown and distributed as to ensure desirable standards of genetic identity, physical purity, and quality attributes.

6.5.1 Procedures for seed certification

The following procedures are adapted for seed certification.

1. Any person intending to produce certified seed must get registered with the provincial seed corporations or agencies, who in turn will submit their names and details to the Federal Seed Certification Department for the official record.

2. Lists of stocks or lots of different kinds of seeds which a farmer or corporation/procurement agency intends to produce are to be sent to the Federal Seed Certification Department for checking and future action. The lists should provide the following details on a prescribed application form:
   a. crop species and variety
   b. category (prebasic, basic, certified) and lot number of the seed used
   c. grower's name and address
   d. area to be sown (hectares)

3. The information provided in the application is checked to make sure that the grower is a bona fide seed producer and that he has used reliable seed.

4. The Federal Seed Certification Department will make arrangements for field inspection by their qualified staff (inspectors) who will verify the following points.
   a. The field contains the commodity which has been specified in the application.
   b. The location and reference number of the field is correct.
   c. The isolation distances meet the prescribed standards laid out for that crop.
   d. The labels and seals of the used containers maintained by the growers are in conformity with the variety and seed lot numbers mentioned in the application.
   f. General condition and appearance of the crop is not poor, weedy, diseased, damaged, or mixed with other seeds.

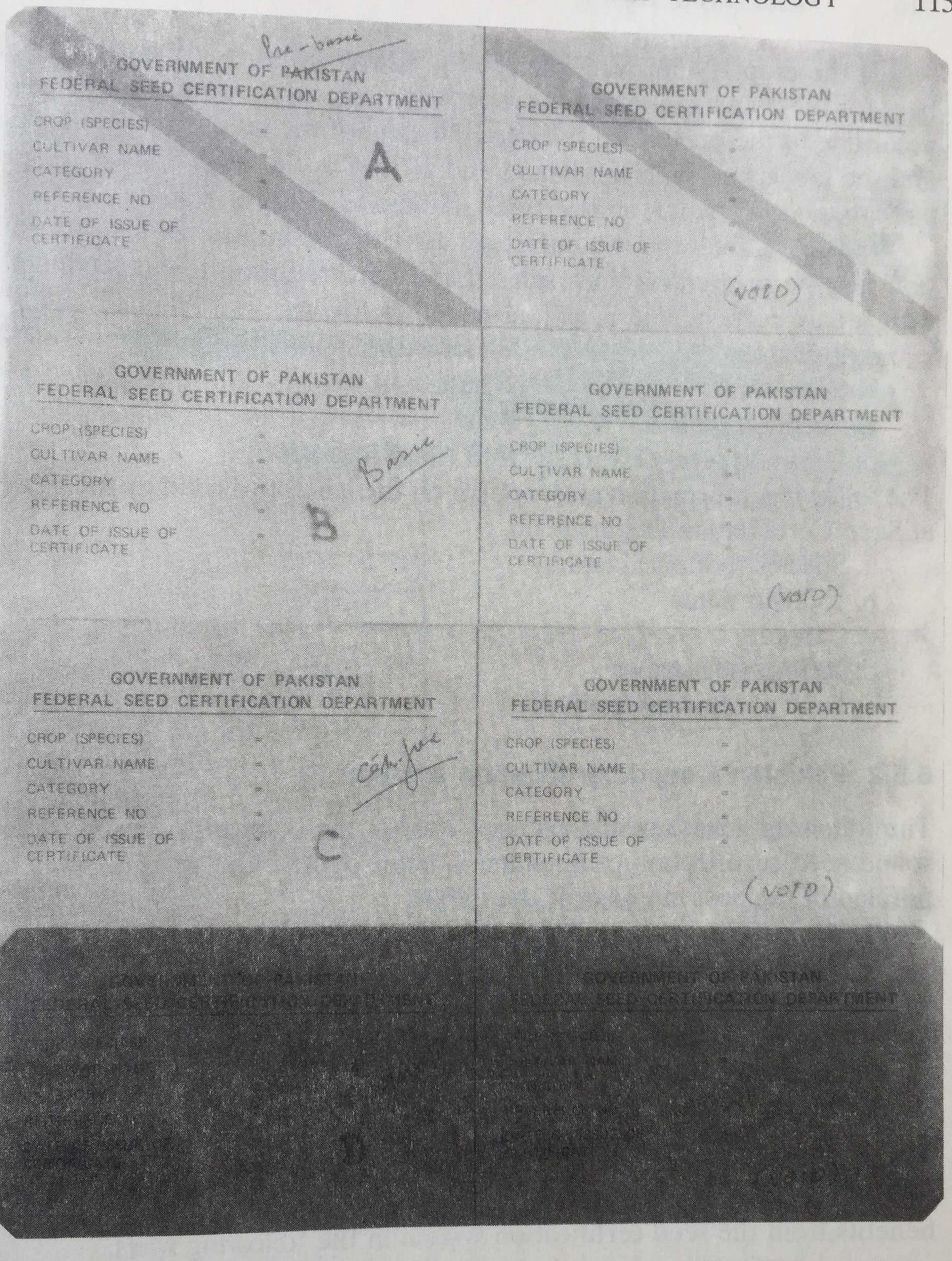

Figure 6.4 Labels for prebasic (a), basic (b), certified-I (c), and certified-II (d) seed. Source: Government of Pakistan, Federal Seed Certification Department.

Besides the field inspections described above, samples from the cleaned seed are tested in the laboratory for purity, germination, presence of diseas- seed are tested in the laboratory for purity, germination, presence of diseases, and moisture content. After careful assessment, the results are commu- es, and moisture content. After careful assessment, the results are communicated to the applicant (grower, corporation, agency, etc.) with comments.

If the crop is approved, the seed producer is provided with sufficient bags for the area he intends to sow. But the process of sampling and testing according to the prescribed rules continues until the seed is finally certified and the labels and seals are issued and affixed to the bags. Labels for pre-basic, basic, certified–I, and certified–II seed are shown in Figure 6.4.

Labels. Labels may be either adhesive or non-adhesive. The information may be printed on both sides. Labels are required to be rectangular with square corners, and be colour-coded as follows.

a. Prebasic	White with diagonal violet line
b. Basic seed	White
c. Certified seed–I	Blue
d. Certified seed–II	Red (improved seed)

The following information must appear on the labels provided by the Federal Seed Certification Department:

a. Species (botanical name)
b. Cultivar name
c. Category
d. Reference number
e. Date of issue of certificate

6.5.2 Pakistan's seed certification system

The following governmental agencies exist in the country to ensure that a sound seed certification programme is implemented and its objectives are fulfilled in the best interests of the public.

1. Federal Ministry of Agriculture
2. National Seed Council
3. Four Provincial Seed Councils/Seed Corporations
4. Federal Seed Registration Committee
5. National Seed Registration Department
6. Federal Seed Certification Department

Figure 6.5 displays the organization of these agencies.

Advantages of certification. Agricultural development as a whole benefits from the seed certification system in the following ways.

1. Growers get high-quality and genetically pure seed.
2. Seed merchants deal in authentic and high-quality seed.
3. Seed producers act on an already-established, rigorous quality control programme that is usually beyond their own resources.
4. Farmers get the desired variety in the form of certified seed with all the characteristics they are looking for.

Seed legislation. Seed laws are designed to guarantee the smooth and orderly marketing of seed and provide legal protection to buyers and sellers.