

Paper 11

HYBRID MAIZE SEED PRODUCTION

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INTRODUCTION

Hybrid maize seed first became available to growers in the U.S.A. in the early 1920s. Since then, there has been a dramatic increase in maize grain yields in temperate regions of the world with more than 50% of this gain attributed to the use of hybrid seed (Russell, 1974; Duvick, 1977; Castleberry *et al.*, 1984).

Growers throughout temperate regions, including New Zealand, are now able to select from a range of scientifically bred, carefully produced, hybrid cultivars that are suited to their specific growing areas and production requirements. These hybrid cultivars differ in grain yield potential, maturity, standability, grain drying rate and resistance to pests and diseases. The best hybrid cultivars produce high yielding, uniform crops under favourable soil and climatic conditions while maintaining better yields than older hybrids or open-pollinated varieties under unfavourable conditions (Castleberry *et al.*, 1984).

TYPES OF HYBRIDS

Hybrid cultivars are produced by crossing together inbred lines. Inbred lines are lines which have been self-pollinated (crossed with themselves) for 5-7 generations to produce genetic uniformity. During the inbreeding phase, selection is practised for uniformity and for the ability of the line to produce desirable hybrids.

There are several ways of combining inbreds to form different types of hybrids (Aldrich *et al.*, 1975). Four of these are single cross (SX), three-way cross (3X), double cross (DX) and modified single cross (MSX) (Table 1).

Table 1: Types of maize hybrids.

Hybrid type	Seed parent	Pollen parent	Hybrid
Single cross	inbred A	inbred B	AB
Three way cross	single cross AB	inbred C	ABC
Double cross	single cross AB	single cross CD	ABCD
Modified single cross	single cross AA'	inbred B	AA'B

In the modified single cross the two inbreds used to produce the seed parent are closely related sister lines which differ genetically just enough to result in a little hybrid vigour.

The single cross hybrid is very uniform in plant and ear height. Uniformity decreases with more inbreds used and crosses made. The double cross, because it involves four unrelated inbred lines, will normally be the least uniform of all.

COMPANIES INVOLVED

Hybrid maize seed production in New Zealand is carried out by three companies. These are Arthur Yates & Co., based in the Waikato, and Dalgety Crown and Corson Seeds International, both based in the Gisborne area.

The principles involved in the production of seed crops by these companies are the same, but some of the operations may be carried out differently. The practices outlined here are those used in the production of Pioneer hybrids by Arthur Yates & Co.

CROP PRODUCTION

Most seed crops are grown under contract with individual growers. For the grower, the agronomy of the crop — cultivation, herbicide and fertiliser application — is similar to commercial grain crops. But because the value of the crop is much greater and inbred lines are less vigorous than hybrids, a greater attention to detail is required to ensure a high quality final product.

PLANTING

In crossing the two parental lines, one is nominated to be the male (pollen) parent and the other the female (seed) parent. Different planting patterns are used to supply enough pollen from the male parent to fertilise the female silks. The row ratios generally used are six female — two male, or in poor pollen shedders four female — two male. The plants are sown in rows 76 cm apart.

Inbreds may require different times from sowing to anthesis and silking, so the male and female parents may have to be sown at different times to ensure that pollen is

present when the female parent is silking.

Isolation of the seed field from other maize, sweetcorn or popcorn crops is important to ensure genetic purity of the resultant crop. Seed fields require isolation of 400 m from other maize crops to prevent pollination by other than the selected male parent. The greatest contamination occurs in the 75 m nearest contaminating maize, but this can be modified by the use of extra male rows, natural shelter and the direction of the prevailing wind (Craig, 1977).

The optimum insurance against outside contamination is to have the pollen parent shedding pollen just before the silks emerge and producing ample pollen throughout the period when the female silks are receptive.

DETASSELING

During January and early February, as the plants come into tassel, the most critical and labour intensive parts of the hybrid seed production operation commence. This operation is controlled by the companies and not the grower.

Seasonal workers are employed to go through the crop before tasseling to remove any rogue plants — off-type plants or plants that are not going to produce quality seed due to insect or mechanical damage. Roguing maintains genetic purity and ensures an even pollen shedding period.

After roguing, and before pollen shed, the tassels are removed from the female parent. This can be done by hand, either on foot or from machine, or by a combination of mechanical and hand methods. For the hand method from machine, high-rise tractors called 'personnel carriers' move slowly over the crop carrying people to pull the tassels. Generally several passes are required to bring the crop within specified quality control levels.

The mechanical method uses rollers to pull the tassels from the plant or cutters to remove the tassels and upper leaves. For these machines to work properly, the crop has to be even in development. Machine detasseling must still be followed by hand pulling to remove tassels on late or short plants, and from tillers.

The correct timing of detasseling is essential if hybrid seed with a high degree of genetic purity is to be produced. If detasseling is late and pollen shedding occurs on the female parent, the seed is rejected.

HARVESTING

The male rows are removed from the paddock before the female plants are harvested. This is to ensure there is no chance of contamination from ears of the male parent being harvested with the female parent.

When the seed parent has reached physiological maturity, as indicated by the formation of the black layer at the base of the kernel (Daynard and Duncan, 1969), harvest of the female plants can commence. A picker, which harvests the whole ear is used rather than a combine. The reasons for this are:

- to allow inspection of the ears across a sorting table before being conveyed to a drier;

- to maintain maximum germination through gentle handling of the seed.

DRYING

The seed is dried on the cob, in a bin drier, over a period of 3 to 4 days at a maximum temperature of 40°C. Slow drying is important to maintain maximum germination. Too rapid drying, or too high a temperature, can cause cracking of the seed and a resultant decrease in germination.

The seed is usually harvested at about 26 to 28% moisture and dried to 12% before being removed from the cob. The shelling of the seed is another operation where care has to be taken not to damage the seed by cracking.

SIZE GRADING AND TREATING

The seed is cleaned to remove dust and foreign matter. It is then graded into 10 size grades of rounds and flats. This fine separation of size grades is a carryover from the days of plate planters and is not as necessary with the types of planters commonly used in New Zealand today.

Before bagging, the seed is treated with fungicide to give the young seedlings some short-term protection against soil borne diseases.

QUALITY CONTROL

To produce high quality seed, strict quality control levels must be met. These start with the production of the parent inbreds and continue until the hybrid seed is sold.

During the detasseling period, an independent inspector visits the seed crops to check that stringent roguing and detasseling standards are maintained. Records are kept to ensure that each crop is detasseled and rogued to standards which will maintain the genetic purity of the hybrid. If a crop does not meet the detasseling and isolation requirements it will be rejected from hybrid seed sales.

Germination tests are done immediately after harvest and also after size grading, to ensure satisfactory standards are maintained.

As a backup to quality control, a 'growout sample' from each size grade of each hybrid is sown to visually check the purity of each grower's 'lot'.

All lots of seed are kept separate from harvest to the point of sale. This is to ensure that if any problems appear in individual lots, they can be withdrawn from sale.

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