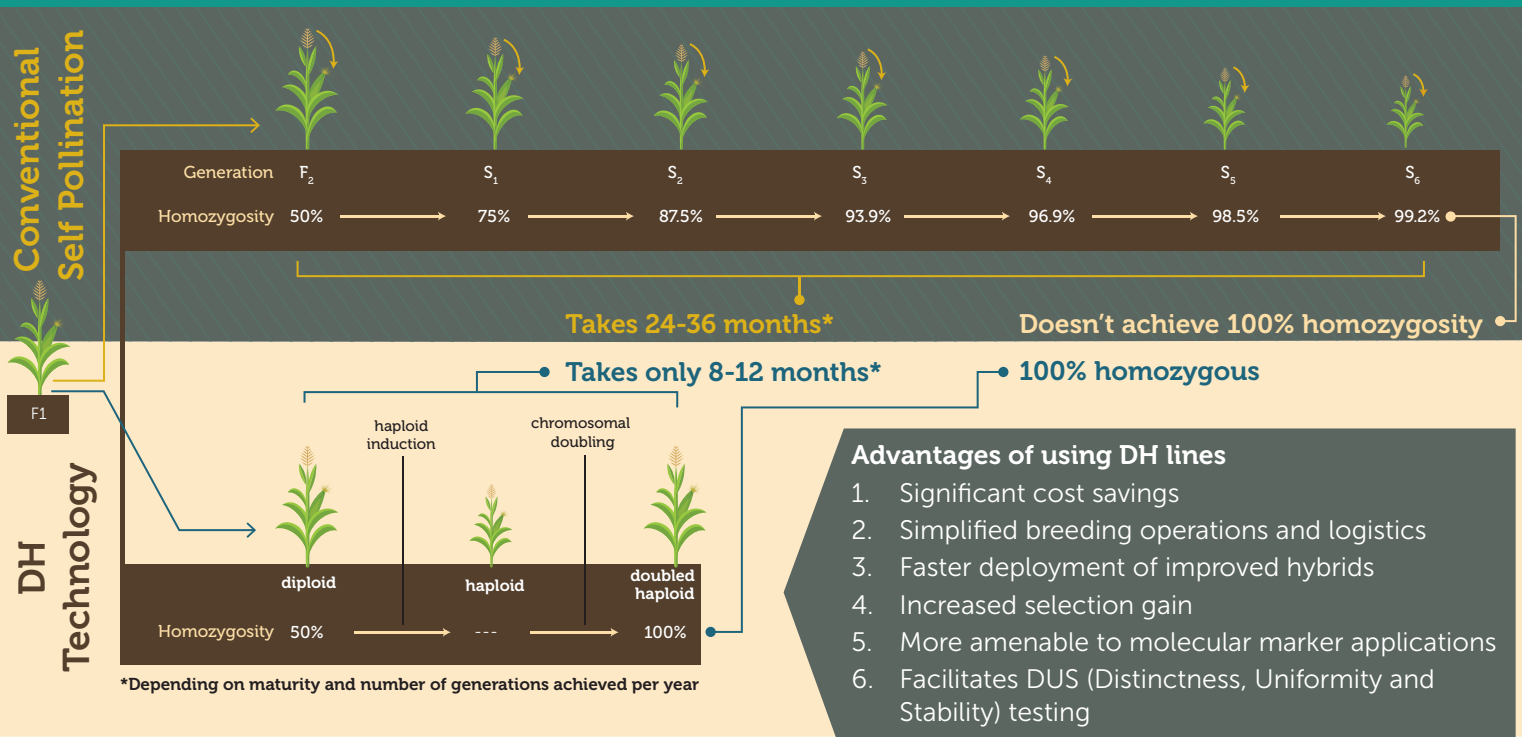
CIMMYT's Maize Doubled Haploid (DH) Line Development Service

Hybrid maize varieties have much higher yields than open-pollinated varieties, and are key to unlocking the agricultural potential of maize producing countries across the developing world. Development and use of genetically homozygous parental lines are fundamental in the hybrid breeding process. Traditionally, breeders have had to grow and self-pollinate maize for 6 to 8 generations to obtain genetically stable inbred lines. The Doubled Haploid (DH) technology is a more efficient alternative to the time-consuming and cumbersome self-pollination method to produce **100% homozygous maize lines in less than half the time.**

DH technology enables production of **100% homozygous** inbred lines in **2 cycles** instead of **6-8 cycles** of conventional inbreeding.



*Depending on maturity and number of generations achieved per year

Advantages of using DH lines

1. Significant cost savings
2. Simplified breeding operations and logistics
3. Faster deployment of improved hybrids
4. Increased selection gain
5. More amenable to molecular marker applications
6. Facilitates DUS (Distinctness, Uniformity and Stability) testing

CIMMYT provides a not-for-profit **maize DH production service** to NARS and private sector breeding programs in Africa and Latin America at its DH facilities in Kenya and Mexico. Public and private sector organizations involved in maize germplasm development are invited to take advantage of these services.

The aim of CIMMYT's DH facilities is to empower maize breeding programs throughout low- and middle-income countries by offering a competitive, accessible, not-for-profit DH production service that will accelerate their rate of genetic gain. The use of DH lines in public- and private-sector maize breeding programs will fast-track development of improved maize varieties for farming communities.

CIMMYT's one-of-a-kind, state-of-the-art maize DH facility in Kiboko, Kenya was established in collaboration with the Kenya Agricultural and Livestock Research Organization (KALRO) and with financial support from the Bill & Melinda Gates Foundation.

For further information on CIMMYT's Maize DH Production Service, please contact:

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CGIAR RESEARCH PROGRAM ON Maize

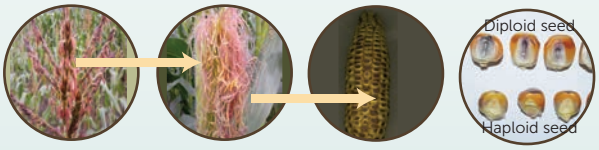
CIMMYT International Maize and Wheat Improvement Center

DH Line Production Process

Haploid induction and identification

To produce haploid seed, the source germplasm/donor is crossed with pollen from "haploid inducers", which are maize genetic stocks that have a special trait that induce formation of a certain proportion of seed with embryos with only half of the normal number of chromosomes ("haploid seed").

Haploid seeds are identified by using a special color marker (*R1-nj* anthocyanin marker).



Inducer *R1-nj* | Donor *r1* | F1 *R1-nj r1*

Chromosome doubling of haploid plants

Plants grown from haploid seeds (generally referred as D_0 plants) only have half of the necessary chromosomes and are sterile, unless there is spontaneous diploidization and fertility restoration.

Haploid seedlings are therefore subjected to a treatment with a mitotic inhibitor chemical called colchicine, which causes the haploid chromosomes to duplicate.

Since both copies of the duplicated chromosomes are identical, the resulting seed will be 100% homozygous unlike conventional inbred lines.

Haploid seed germination

Immersion of D_0 seedlings in colchicine solution

Production of DH lines

Treated haploid seedlings (D_0 plants) are obtained from the greenhouse and transplanted in the field.

The seedlings are very fragile and require special care. Even under optimal agronomic conditions, only a few of the surviving D_0 plants produce pollen. Upon self pollination, a few of those produce seed. Seed obtained from D_0 plants gives out 100% homozygous DH lines.

Seedlings transplanted in D_0 nursery

Self pollinating fertile D_0 plants produce seed for DH lines

Timelines for DH line development service in Kenya

	Submission of the seed	Sowing haploid induction nursery	Harvest of induction nursery	Haploid identification	Planting D_0 nursery	Harvest of DH lines
For Cycle A	by March 15	April	Aug/ Sept	Sept/ Oct	Nov	March
For Cycle B	by Sept 15	Oct	Feb/ Mar	Mar/ Apr	May	Sept

DH facility delivers the seed for DH lines in 8-12 months* from the date of planting the haploid induction nursery to the clients based in Kenya.

Timelines for DH line development service in Mexico

	Submission of the seed	Sowing haploid induction nursery	Harvest of induction nursery	Haploid identification	Planting D_0 nursery	Harvest of DH lines
For Cycle A	by Nov 1	Nov/ Dec	March/ April	May/ June	July	Nov/ Dec
For Cycle B	by April 1	April/ May	Aug/ Sept	Oct/ Nov	Nov/ Dec	April/ May

CIMMYT aims to deliver at least 100 DH lines for each source population submitted by the partner, but the actual number may vary due to various factors inherent to the production process.

DH facility delivers the seed for DH lines in 8-12 months* from the date of planting the haploid induction nursery to the clients based in Mexico.

*For clients from other countries, it takes an additional 2-3 months for seed export.