Hybrid Rice Seed Production

Prepared

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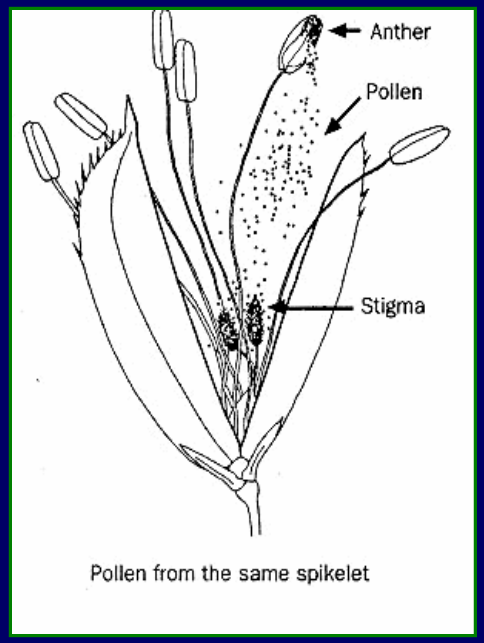
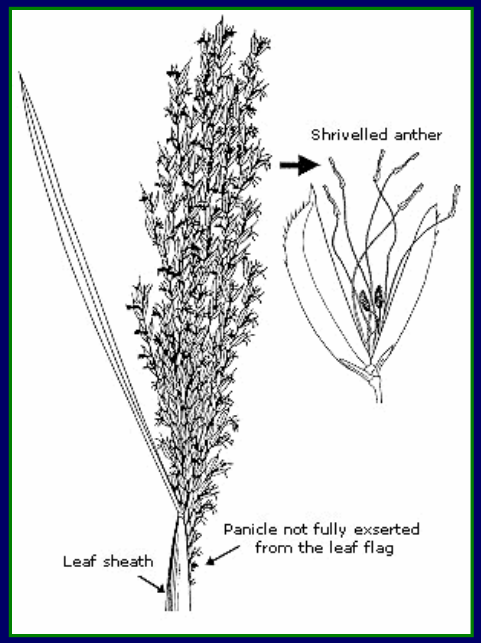
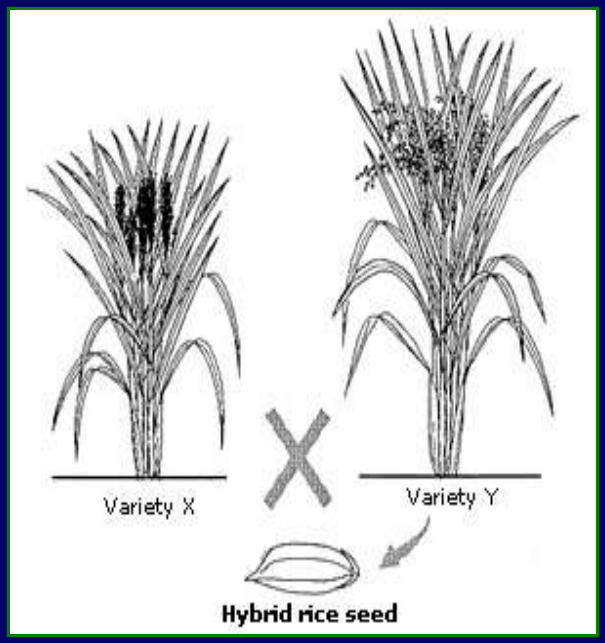
How Hybrid Rice?



Normal Rice Spikelet (self pollinated crop)



Sterile Rice Spikelet (Male Sterility)



Hybrid Seed Production (Male Sterile x Normal Rice)

What is Hybrid rice?

- It was reported by jones(1926) but the successful development is made by chinese during 1970's.
- A Hybrid rice variety, also referred to as the F_1, is the direct product of crossing two genetically different parents.
- In hybrids, the positive qualities of both parents are combined resulting in a phenomenon called "hybrid vigor" or "heterosis.
- These factors result in higher yields than ordinary rice(inbreds).

Why Hybrid Rice?

- **Heterosis (Hybrid vigor) Application to Increase:**
  - Productivity (yield/unit/time, 15-20% of yield advantage), and
  - Economic returns
- **Heterosis**
  - ✓ A universal phenomenon that F1 generation shows superiority to both parents in agronomic traits or yield
  - ✓ It presents in all biological systems and has been exploited commercially in many agricultural crops.

Importance of Hybrid rice:

- More and more rice to be produced on less land and with less inputs.
- Rice hybrids have shown 15-20% higher yield potential than inbred rice varieties under farmers' field conditions.
- Hybrids have shown their ability to perform better under adverse conditions of drought and salinity.

Production of Seed for Hybrid Rice

- Two techniques
  1. Two line system
  2. Three line syste

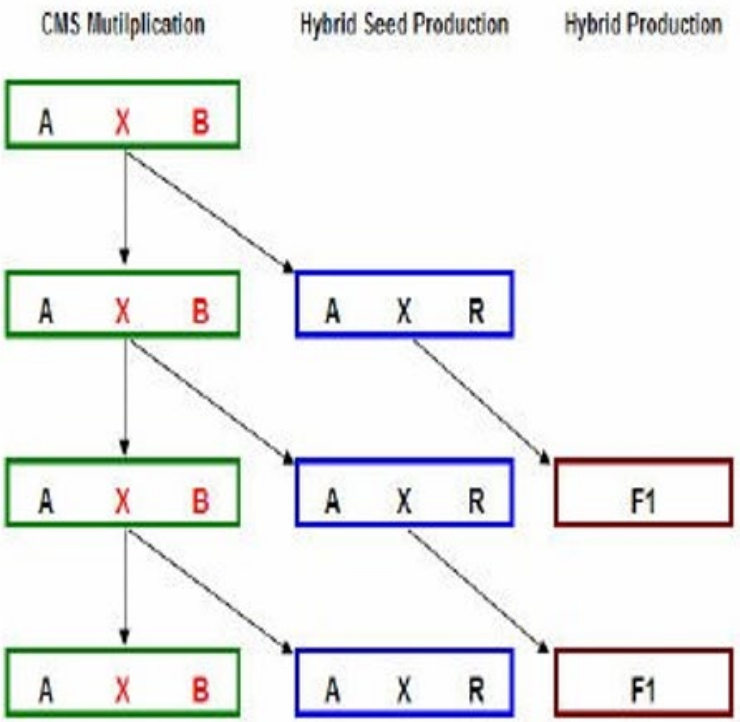
However three line is successful.

It involves three lines they were

1. A line(male sterile line)
2. B line(maintainer line)
3. R line(restorer line)

A*B=A

A*R=R



A line	R line
male characters were suppressed	fertile
small	tall

Male Sterility Systems in Rice

- **Male sterility: a condition in which the pollen grain is unviable or cannot germinate and fertilize normally to set seeds.**
- **Male Sterility Systems (genetic and non-genetic):**
  - ✓ **Cytoplasmic genetic male sterility (CMS)**

    Male sterility is controlled by the interaction of a genetic factor (S) present in the cytoplasm and nuclear gene (s).

  - ✓ **Environment-sensitive genic male sterility (EGMS)**

    Male sterility system is controlled by nuclear gene expression, which is influenced by environmental factors such as temperature (TGMS), daylength (PGMS), or both (TPGMS).

  - ✓ **Chemically induced male sterility**

    Male sterility is induced by some chemicals (gametocides)

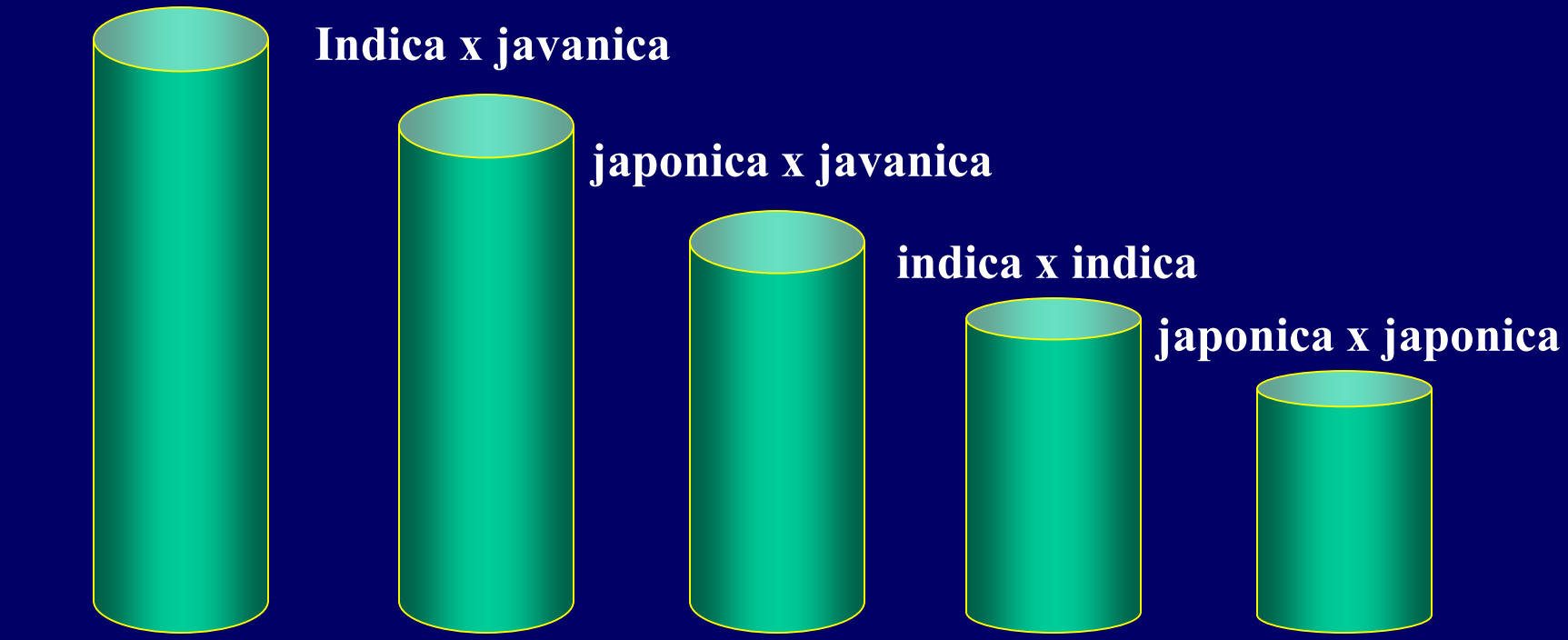
Advantage & Disadvantage of 3-line hybrid rice system

- **Advantages**
  - ✓**Stable male sterility**
- **Disadvantages**
  - ✓**Limit germplasm source (CMS, Restorer)**
  - ✓**Dominant CMS cytoplasm in large area (WA)**
  - ✓**One more step for parental seed production**
  - ✓**Time consuming of CMS breeding**

Advantage & Disadvantage of 2-line hybrid rice system

- **Advantages**
  - ✓ **Simplified procedure of hybrid seed production**
  - ✓ **Multiple and diverse germplasm available as parents**
    - ✓ **Any line could be bred as female**
    - ✓ **97% (2-line) vs 5% (3-line) of germplasm as male**
  - ✓ **Increased chance of developing desirable & heterotic hybrids**
  - ✓ **Multiple cytoplasm courses as female parents**
- **Disadvantages**
  - ✓ **Environmental effect on sterility could cause seed purity problem**

Hybrid Heterosis in Rice



Hybrid Rice Seed Production

In Asia

In United Sates

Future Opportunity:

Improve agronomic management and deployment strategy

Unhealthy → Healthy canopy

ShanYou 63 grown under different nitrogen management
(S. Peng, IRRI)

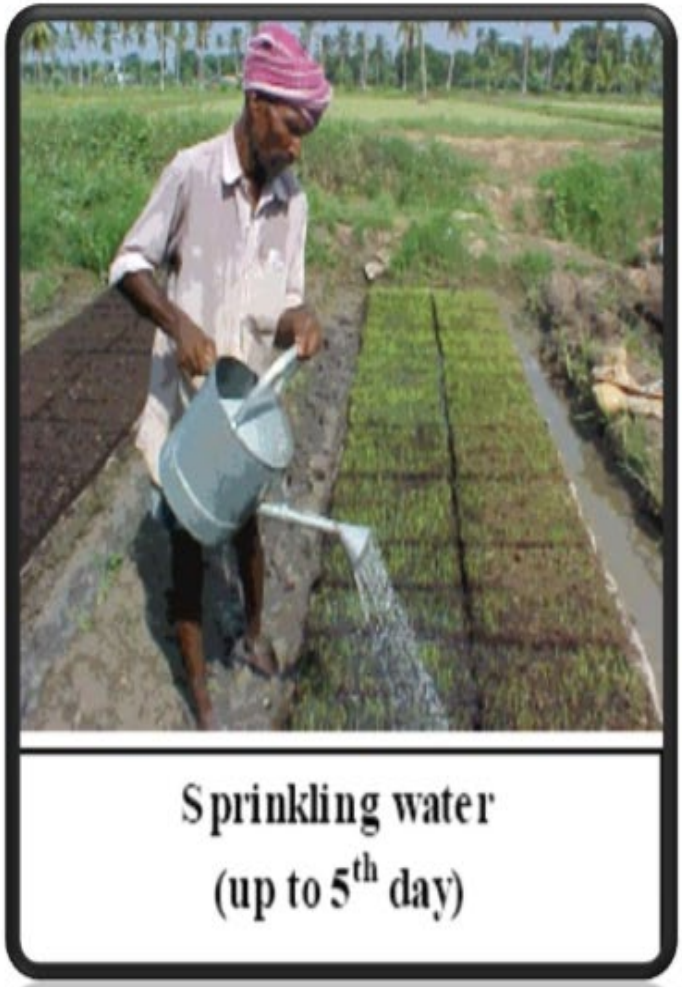
The common Practice

- Transplanting young seedlings (less than 14 days old) .
- Careful transplanting of single seedlings per hill .
- Transplanting in a square pattern, preferably with 25 x 25 cms spacing .
- Emphasis on organic fertilizers .
- Weeding through weeders to increase aeration as well as weed control .
- Alternate wetting and drying up to the panicle initiation stage through irrigation by way of a thin film of standing water.

Mat Nursery:

Sowing sprouted seed

Removing seed frame



Sprinkling water
(up to 5th day)

Modified Rice Mat Nursery

Benefits

- Improvement in yield.
- More tillers will produced.
- Seed requirement reduced.
- Decrease in environmental pollution through lowered use of chemical fertilizers and agrochemicals.
- Substantial water savings.