# WELCOME

## **DISTANT HYBRIDIZATION**

#### MAHESH.R.HAMPANNAVAR

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#### DISTANT/WIDE CROSS

Hybridization

- crossing between two **genetically dissimilar** parents is called hybridization.
- **Wide Hybridization**
- Interspecific Hybridization:- Crosses made between distantly related species
- Intergeneric Hybridization:- Crosses made between distantly related genera
- Hybridization (recombination) is the third major evolutionary process with an importance not exceeding that of mutation and natural selection.





produced.

**Rimpu** (1890):

Produce the first intergeneric hybrid triticale which have greater potential than raphanobrassica.







X







Intergeneric cross

### WHEAT



### Difficulties encountered in wide cross hybrids

✓ Failure of zygote formation
✓ Failure of zygote development
✓ Failure of F<sub>1</sub> seedling development

#### **Major distant cross barriers**

I.	Temporal and spatial isolation of species			
II.	Pre-fertilization barriers			
	On the surface of the stigma before pollen tube entry			
	Inside the tissues of the stigma and style			
	Inside the ovary and embryo sac			
III.	Post fertilization barriers			
	Non viability of hybrid embryos			
	Failure of hybrid to flower			
	Hybrid sterility			
	Lack of recombinant			
	Hybrid breakdown in F2 or later generation	14		



# I. Temporal and spatial isolation of parental species

 Non synchronous flowering of the parental species due to different agro-ecological or geographical background

#### Overcome

- 1. Early/staggered sowing
- 2. Suitable photoperiodic treatment
- 3. vernalisation

# A. Inhibition on the stigma surface



#### A. Inhibition on the stigma surface

- Result in the arrest of pollen germination or pollen tube entry into the stigma
- ✓ One of frequent barriers, particularly in distantly related species

# The causative factors for the failure of pollen germination:

- 1. Lack of effective adhesion
- 2. Lack of full hydration
- 3. Absence of pollen germination factors on the stigma
- Pollen adhesion and hydration are prerequisites for germination

#### **II. Pre-fertilization barriers**

#### Pollen adhesion

- Largely depends on the nature and extent of the surface component of the pollen and the stigma
- $\checkmark$  It is not a constraint in species having wet stigma

#### Pollen hydration

- ✓ The result of the transfer of water from the stigma to the pollen through an osmotic gradient
- Insufficient hydration may result in crosses in which the osmotic potential of the pollen does not match that of the stigma

### Technique to overcome barriers in the stigma

- ✓ Effective pollination
- Correct place
- Correct time
- Rub stigma before

Mentor pollination
 Pollen which is fully compatible with the intended seed parent



#### B. Inhibition in the stylar region

- $\checkmark$  Failure of the pollen tube to reach the ovary
- ✓ places
- 1. Just below stigma
- 2. Further down the style
- $\checkmark$  Arrested pollen tubes often show abnormalities in the form:
- $\checkmark$  Growing pollen tubes utilize stylar nutrients.

### **Technique to overcome barriers in the stylars**

- ✓ Reciprocal crosses
- ✓ Mentor pollination
- $\checkmark$  Use of plant growth regulators
- ✓ Pollen may have to be applied in a medium favoring germination to compensate for deficiencies in the immature stigma
- # By pass stigma and style completely and apply pollen directly to the ovule

#### **III.** Post-fertilization barriers

 $\checkmark$  Result in the failure of fertilized ovules to develop into mature seeds

✓ operate at different stages of embryo development

Factors:

- $\checkmark$  Unbalance of ploidy levels
- $\checkmark$  Abnormalities in the embryo development
- $\checkmark$  The presence of lethal genes
- $\checkmark$  Genic disharmony in the embryo
- ✓ Failure or early breakdown of endosperm

### **Techniques to overcome:**

- $\checkmark \quad \text{Removed of competing sinks}$
- $\checkmark \quad \text{Reciprocal crosses A X B} \quad \text{BXA}$
- ✓ Manipulation of ploidy level
- ✓ Embryo rescue
- $\checkmark$  Use of plant growth regulators

### Techniques to remove the crossability barriers in distant hybridizarion :

○ Embryo rescue

 $\circ$  with shorter style- as female parents

- A part of style may be cut off
- Autopolyploid: B. oleracea(cabbage) and B. campestris (turnip rape) do not cross with each other at the diploid level, but they produce embryos, when tetraploid species

- Bridge species.
- Transfering resistance to eye spot from Ae. ventricosa to T. aestivum, T. turgidum is used as a bridge sp.
- Use of growth regulator e.g. IAA, 2,4-D, napthelene acetamide.
   Eg;- N. tabacum does not hybridize with N. rependa, but this cross is possible when IAA applied to pedicle of flowers in a lanoline paste.

## Somatic hybridization technique :

- 1. isolation of protoplast
- 2. Fusion of the protoplasts of desired species/varieties
  - 3. Identification and Selection of somatic hybrid cells
- 4. Culture of the hybrid cells
- 5. Regeneration of hybrid plants

## **Embryo rescue :**

- Embryo rescue
- endosperm degeneration:-EBN
- hybrid rescue.
- e.g.; H. vulgare x Secale cereale.
- Lack of nutrient in endosperm for germination



• 'Wide'' crossing of wheat and rye requires embryo rescue and chemical treatments to double the no. of chromosomes triticale



## Limitations of embryo rescue :

- High cost of obtaining new plantlets
- Deleterious mutations
- A sophisticated tissue culture laboratory
- Specialized skill

## **Requirement of distant hybridization :**

- Diseases and insect resistance
- Quality
- Wider adaptation
- Mode of reproduction
- yield
- Development of new varieties
- Production of new crop species (e.g; Triticale hexaploid)
- Transfer of cytoplasm
   Mahesh R Hampannavan

TABLE 25.2. Resistance to diseases and insects transferred through interspecific hybridization in different crops

Сгор	Quality transferred	Species transferred from	Species transferred to
Cotton	Jasssid resistance	Gossypium tomentosum	G. hirsutum
	Smoothness for boll weevil resistance	G. armourianum	G. hirsutum
	Rust resistance	G. raimondii	G. hirsutum
	Blackarm resistance	G. arboreum	G. barbadense
Tobacco	Resistance to mosaic virus	Nicotiana glutinosa	N. tabacum
		N. repanda	N. tabacum
	Resistance to wild fire and	N. longiflora	N. tabacum
	blackfire diseases.		
	Resistance to blue mould black	N. debneyl	N. tabacum
Cumment	root rot, wild fire and <i>Fusarium</i> wilt.		
Sugarcane	Seren disease resistance	Saccharum spontaneum	S. officinarum
Potato	roll and virus X.	Solanum denissum	S. tuberosum
Wheat	Resistance to eyespot	Aegilops ventricosa	Triticum aestivum
	Rust resistance	Agropyron	T. aestivum
Peanut	Resistance to leaf chewing insects	Arachis monticola	A. hypogaea
Strawberry	Red stele and aphid resistance	Fragaria chiloensis	Cultivated strawberry
Okra	Resistance to yellow mosaic virus	Abelmoschus manihot	A. esculenta

TABLE 25.3. Improvement in quality and other characters through use of wild species and distant hybridization in some crop plants

	O Philip I	Species		
Crop ·	Quality character	Transferred from	Transferred to	
Cotton	Fibre length	Gossypium thurberi and G. raimondii	G. hirsutum	
Palm	Oil quality	Wild species	Cultivated species	
Rice, Oats and Rye	Seed protein	Wild species	Cultivated species	
Tomato	Carotenoid Content	Lycopersicon hirsutum	L. esculentum	
Tabacco	Leaf quality	Nicotiana debneyi	N. tabacum	
Potato	Starch content	Wild species	Cultivated species ·	
Oat	High oil content	Avena sterilis	A. sativa	
Other characters				
Cotton	Male sterility	Gossypium harknessii	G. hirsutum	
Potato	Frost resistance	Solanum acaule	S. tuberosum	

## Alien addition lines :

• 2n+2=Alien addition lines

2n+1=Alien addition monosome.

 The main purpose of alien addition is the transfer of disease resistance from from related wild species.
 e.g. transfer of mosaic resistance from Nicotiana glutinosa to N. tabacum.  The alien addition lines have been developed in case of wheat, oats, tobacco and several other species.

 Alien addition lines are of still agricultural importance since the alien chromosome generally carries many undesirable genes.

### Alien substitution lines :

- This line has one chromosome pair from a different species in place of the chromosome pair of the recipient species.
- When a single chromosome (not a pair) from different species in place of a single chromosome of the recipient species.
- Alien –substitution lines have been developed in wheat, cotton, tobbacco, oats..
- The alien substitution show more undesirable effects than alien additions and more useful in agriculture.

## Limitation of distant hybridization

- Incompatible crosses
- F<sub>1</sub> sterility ;-
- Problems in creating new species
- Lack of homeology between chromosome of the parental species
- Undesirable linkage
- Problems in the transfer of recessive oligogenes and quantitative traits
- Lack of flowering in F<sub>1</sub>
- Dormancy, F2 Segregation
- Problem in using improved variety

## ACHIEVEMENTS

- VARALAKSHMI
- DH7
- SUGERCANE NOBELISATION
- PARBHANI KRANTI (A. esculentus X A. maniot)
- BARJA-NAPIER GRASS

## REFERENCES

- PLANT BREEDING PRINCIPLE AND METHODS , page no 669-691
   B.D.SINGH
- ESSENTIAL OF PLANT BREEDING page no 228-242
   PHUNDAN SINGH

# • conclusion



#### SOWN SEED AND LEABNED THINGS NEVER BUIN

# THANK YOU