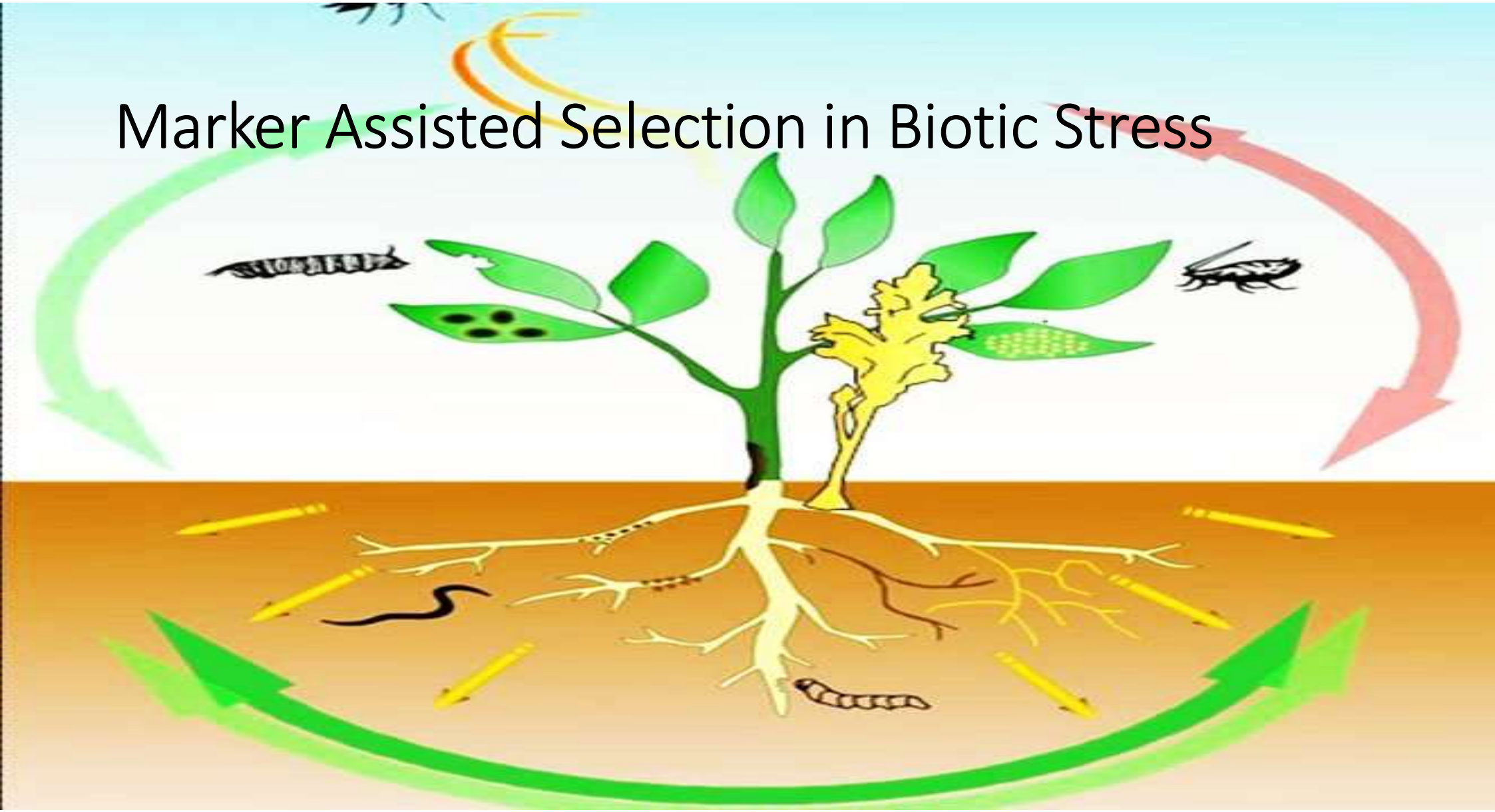
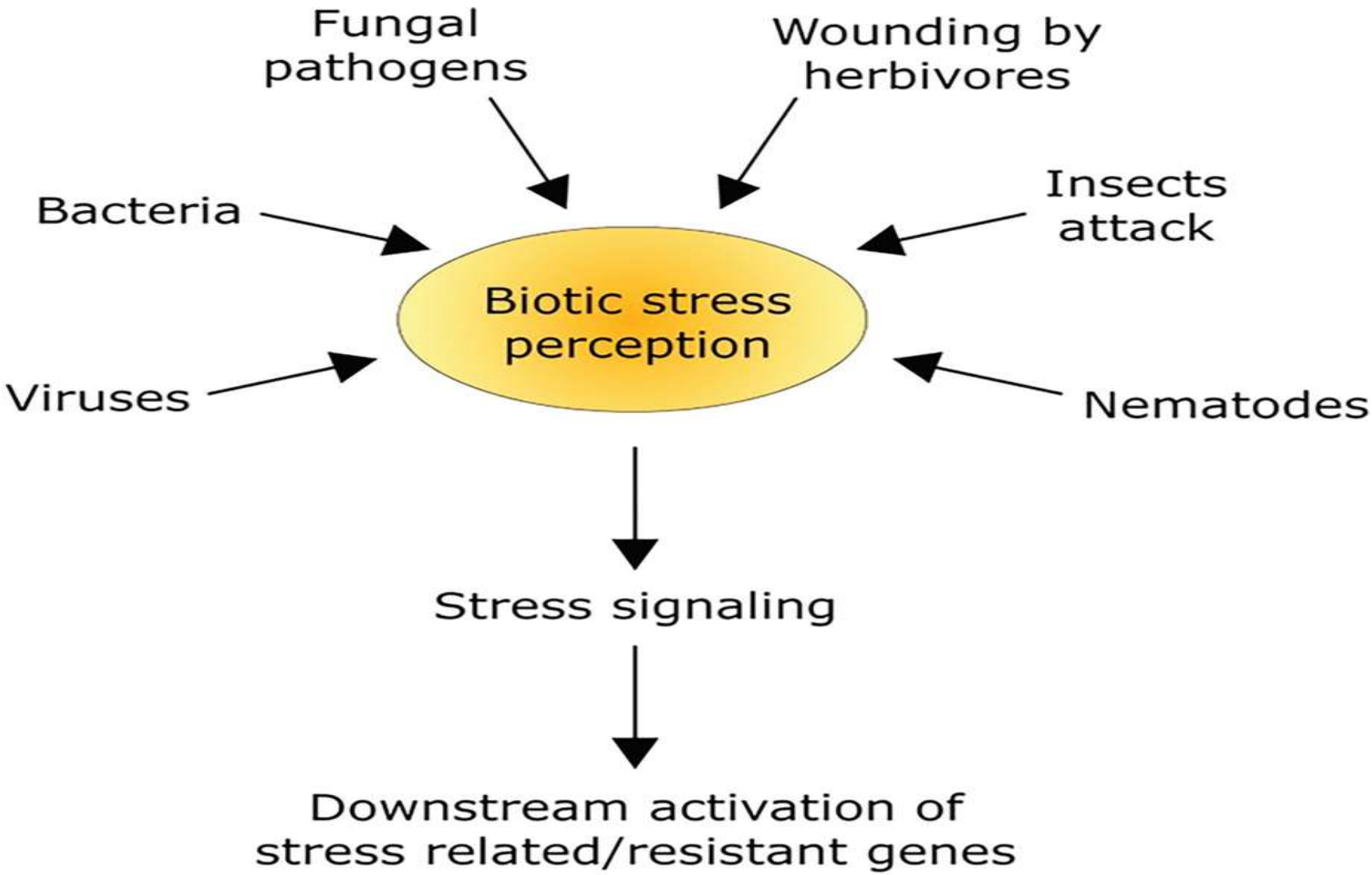
Marker Assisted Selection in Biotic Stress



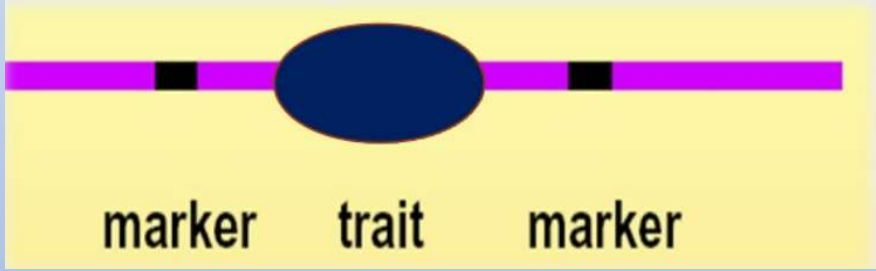
Stress-Stress in plants refers to external conditions that adversely affect growth, development or productivity of **plants** .
Stresses trigger a wide range of **plant** responses like altered gene expression, cellular metabolism, changes in growth rates, crop yields, etc. ... Such **plants** will be considered to be **stress** susceptible.

- **Biotic stress** is stress that occurs as a result of damage done to an organism by other living organisms, such as bacteria, viruses, fungi, parasites, beneficial and harmful insects, weeds, and cultivated or native plants.
- It is different from abiotic stress, which is the negative impact of non-living factors on the organisms such as temperature, sunlight, wind, salinity, flooding and drought.
- The types of biotic stresses imposed on an organism depend the climate where it lives as well as the species' ability to resist particular stresses.

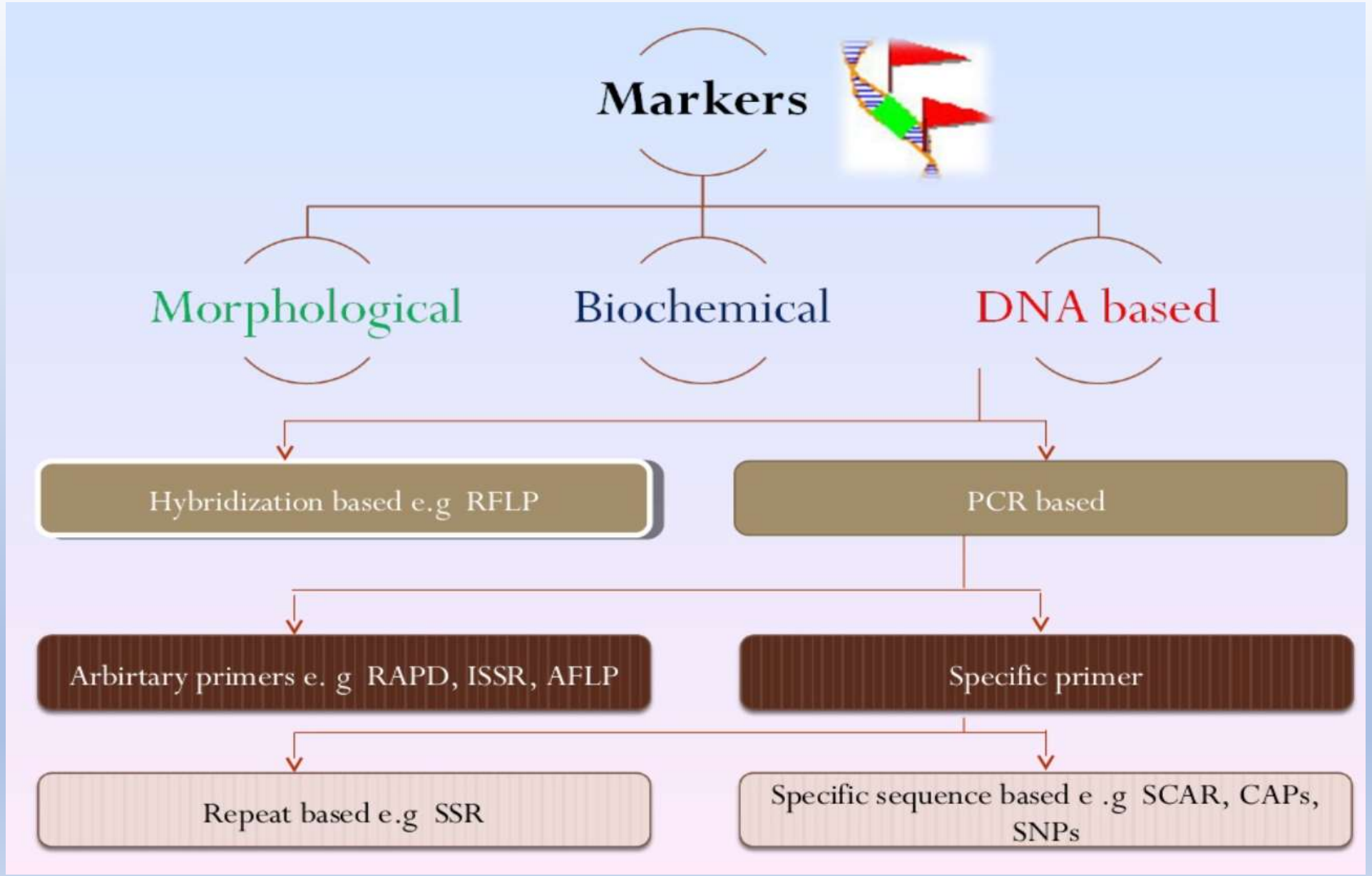

Fungal pathogens
Wounding by herbivores
Bacteria
Insects attack
Biotic stress perception
Viruses
Nematodes
Stress signaling
Downstream activation of stress related/resistant genes

WHAT IS A MARKER?

- All living organisms are made up of cells that are programmed by genetic material called DNA. This molecule is made up of a long chain of nitrogen-containing bases (there are four different bases-adenine [A], cytosine [C], guanine [G] and thymine [T]).
- A Molecular marker is a small region of DNA showing sequence polymorphism in different individuals with in a species (or) among different species.



- It is readily detected and whose inheritance can easily be monitored.
- A wide range of molecular techniques are now available to detect the polymorphism at DNA level.


Markers
Morphological
Biochemical
DNA based
Hybridization based e.g RFLP
PCR based
Arbirtary primers e. g RAPD, ISSR, AFLP
Specific primer
Repeat based e.g SSR
Specific sequence based e .g SCAR, CAPs, SNPs

DIFFERENT TYPES OF MOLECULAR MARKERS

MARKER-ASSISTED SELECTION

- According to Bertrand and Mackill (2008), "**The marker aided selection (MAS) assumes that the target gene is identified and selected based on the closely linked markers".**
- A successful MAS requires that a gene be mapped and closely linked to a marker, otherwise which is very difficult to examine or evaluate by conventional approaches.

Why Marker Assisted Selection ?

- Selection at seedling stage possible.
- Selection of traits with low heritability.
- Distinguishing homozygotes from heterozygotes.
- Pyramiding of Resistance Genes.
- Selection for recessive gene, etc.

Overview of 'MAS'

Mapping populations

- F2 progenies
- F2 derived F3 (F2:3)
- DH lines
- BC progenies'
- RILs
- NILs, Els & ABPs

(1) LEAF TISSUE SAMPLING

(2) DNA EXTRACTION

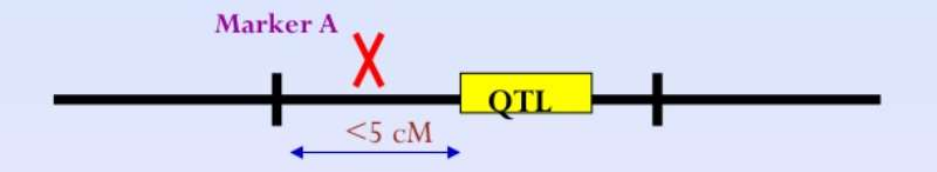
(3) PCR

(4) GEL ELECTROPHORESIS

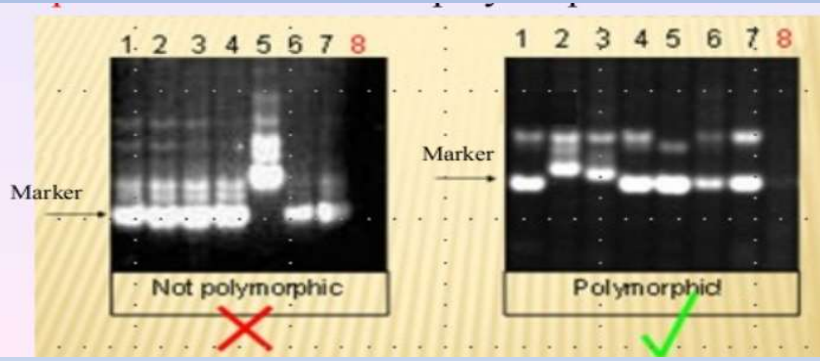
(5) MARKER ANALYSIS

ESSENTIAL REQUIREMENTS FOR MAS SELECTION

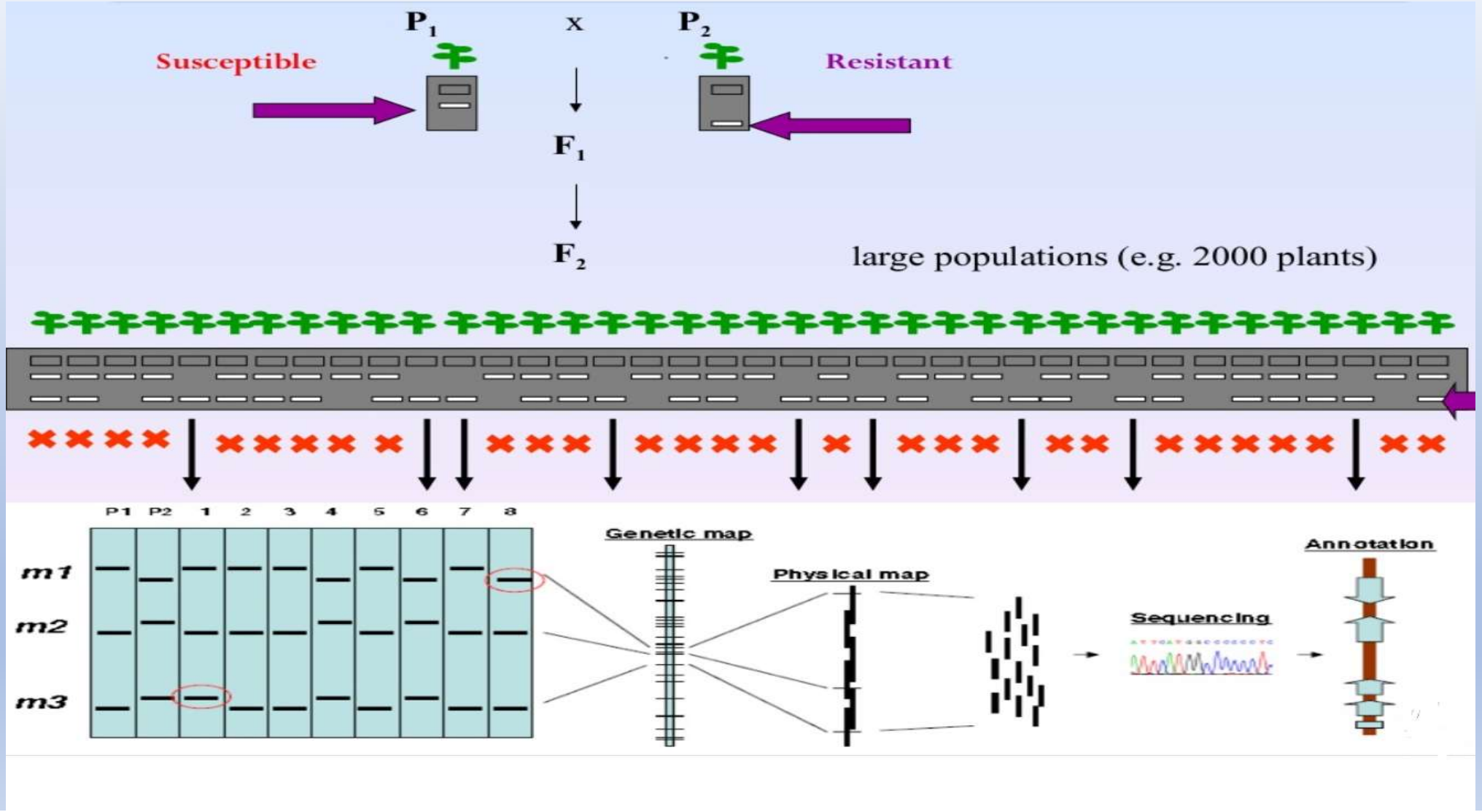
- Reliability: Marker should co-segregate or be closely linked with the desired trait.
- DNA quality and quantity: some marker technique require large amount and high quality of DNA.



- Technical procedure: The screening technique should have high reproducibility across laboratories.
- Cost: It should be economical to use and be user friendly.
- Level of polymorphism: Marker must be polymorphic.



PROCEDURE IN MARKER DEVELOPMENT FOR DISEASE RESISTANT



- Plants are equipped with a variety of mechanisms to defend themselves against infection by fungi, viruses, bacteria, nematodes, insects, and even other plants.
- After the rediscovery of Mendel's laws, plant breeders have used disease resistance (R) genes to produce more resistant varieties.
- Plant defenses are activated by the specific interaction between the product of a disease (R) resistance gene in the plant and the product of a corresponding avirulence (Avr) gene in the pathogen (Flor, 1971).

Properties of R-gene:

"R" genes enable plants to recognize specific races of a pathogen and mount effective defence response including a rapid induction of localized necrosis at the site of infection (the hypersensitive response), increasing expression of defence-related genes, production of anti microbial compounds, lignin formation and oxidative burst in many plant-pathogen interactions

MAS breeding in plants

Soybean: (SCN resistance)

- The soybean cyst nematode (SCN), is worldwide main pathogen of soybean. The most efficient and economical control method is the use of resistant cultivars.
- But the development of resistant cultivars is limited due to certain factors which is time consuming, laborintensive and requires much space in the greenhouse.
- The development of 1, 000 microsatellites (SSRs) led to the construction of a consensus map for soybean Thus, the markers near important QTL can be used as marker for finding regions in the linkage map.
- This study evaluated the effectiveness of using microsatellite near the loci rhg1 and Rhg4, for the selection of soybean lines resistant to SCN.

Soybean: (Aphid resistance)

- In 2000 soybean aphid become a new soybean pest in North America in 2000.
- Resistant to soybean aphid was identified in Dowling, a maturity group VII cultivar .
- Cross is done between Dowling resistant and Loda (susceptible cultivar) and tested lines for resistance.
- At fifth cross we get 99.6% resistant plant breeding line.

RICE

In rice MAS has been successfully used for developing cultivars resistant to bacterial blight and blast. For bacterial blight resistance four genes (Xa4 , Xa5 , Xa13 and Xa21) have been pyramided using STS (sequence tagged site) markers.

For blast resistance, three genes (Pil, Piz5 and Pita) have been pyramided in a susceptible rice variety Co 39 using RFLP and PCR based markers.

The pyramided lines showed higher level of resistance to bacterial blight pathogen.

In Indonesia, two bacterial blight resistant varieties of rice viz Angke and Conde have been released by MAS.

Sorghum	Head smut	-	Fertility restoration
Soybean	Cyst nematode	-	Linolenic acid
	Mosaic Virus		Content
Pea	Fusarium wilt	-	Nodulation ability
	Powdery mildew		
Tomato	Yellow leaf curl virus	-	-
	Black mold		
	Bacterial wilt		
Potato	Cyst nematode	-	-
	Potato virus x		
	Late blight		
Sunflower	Downy mildew	-	-
Chick pea	-	-	Double podding
Barley	Powdery mildew	-	-
	Stripe rust	-	
Mung bean	Powdery mildew	-	-


Thank
you