

Molecular Breeding and Genetic Engineering for Soybean Improvement

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International Soy Conclave
9-10 October, 2021

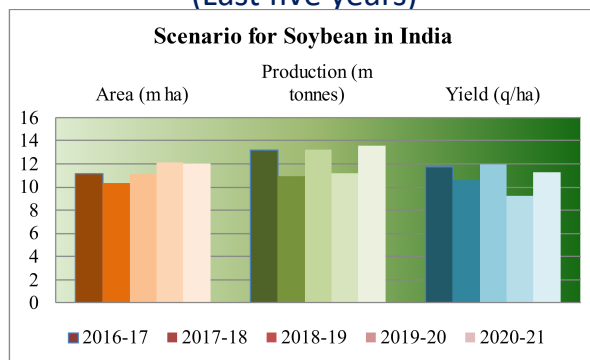


Major Challenges in Soybean Production

- **Abiotic stresses**
 - Drought, water logging
- **Biotic stress**
 - Diseases
 - Insects Pests
- **Other challenges**
 - Weed control
 - Seed Germination
- **Development of improved varieties**
 - Higher yield
 - Tolerance to biotic and abiotic stresses
 - Improved seed composition traits
 - Early maturity
 - Wider adaptability



Soybean Area and Production (Last five years)



Molecular Approaches for Drought Tolerance



Screening of 4000 soybean Germplasm lines

Drought stress is induced at critical stage

Identification :

Unique drought tolerant line

Molecular markers

Gene for drought tolerance

Molecular Breeding for drought tolerance

New soybean varieties developed with enhanced drought tolerance



Best genotypes for drought adoptive traits

GW175 (EC 550828) GW201 (CAT1341) GW281 (TGX 297-16 F)



Genomics for Water logging tolerance



Screening germplasm : 300 soybean lines
Water logging stress induced for 10-12 days
New unique soybean lines identified
Soybean varieties being developed
Molecular markers being developed for water logging tolerance

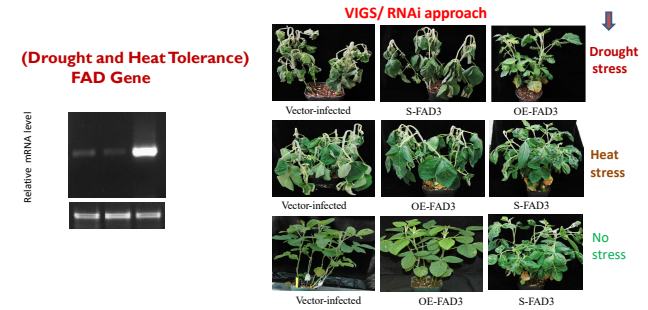
GM Soybean for Drought Tolerance

- Identified new genes for drought tolerance
- Transgenic soybean lines are being developed
- **Transgenic Approach:**
 - Gene Knockout (Soybean Gene)
 - Over-expression (Over expression of soybean gene)



Vector-infected S-FAD3 OE-FAD3

Genetically modified Soybean for Heat Tolerance



Faster approach for enhancing drought/heat tolerance

**Root Trait
Architecture studies**



Root length
Root density
Root angle
Identification of Gene/Marker



Molecular Studies for Soybean Diseases

YMV
Anthracnose
Charcoal Rot
Rust
Bud Blight



Screening for anthracnose resistance



Seed composition trait

- High Oleic acid content
 - High Oil content
 - KTI free
 - Lipoxygenase free
 - Linolenic acid
 - Phytate
 - Raffinose
 - Stachyose
- Protein 40 %
 - Oil 20 %
 - Oleic acid 20 %



Genome Editing for seed composition

- **Genome Editing**
 - Modification done within soybean DNA
 - Small change in DNA/mutation
 - Genome editing has numerous advantages
 - Most significantly that it allows for:
 - Targeted, single gene mutation
- Whole Genome Sequencing
- 40,000 Genes



Genome Editing in Soybean

- High oleic acid content
- Disease resistance
- Other seed composition traits



Commercially cultivated GM and Genome edited soybean

- Glyphosate-resistant soybeans
- Glyphosate-resistant soybean with Cry1Ac protein from *Bacillus thuringiensis*
- High oleic soybean (oleic acid greater than 80 %)

Genome edited soybean

- Calyno High Oleic Soybean Oil (First gene edited food)

Summary

- Advance molecular approaches applied for soybean improvement
- GM soybean research is in progress for enhancing drought tolerance
- Genome Editing initiated for improving seed composition traits
- Biosafety issues are manageable

Thanks

