Waterlogging tolerant *Gossypium hirsutum* germplasm accessions

Dr SESA Khader*, M Saravanan, Annie Sheeba , J H Meshram & Punit Mohan

Vinita Gotmare
Principal Scientist,
Central Institute for Cotton Research, Nagpur, India

Background.....

Waterlogging is one of the major constraints to cotton production in developing countries such as India, Pakistan , and China (Pang et al., 2004) [* Bangladesh !!!]

In Australia losses due to waterlogging are approximately $A180 million (Price, 1993)

Yield reduction could be 10 – 40 %

In India, out of the 58865 ha of cotton grown in the district of Guntur, 16,736 ha has been affected by waterlogging (The Hindu, Sept 20, 2010)

Effetcs of Waterlogging in cotton

- a susceptible crop for waterlogging

the occurrence and extent of response depends on the species or the cultivar, its age and stage of development, duration , depth , time of flooding and soil type

- altered shoot and root hormonal status and nutrient uptake

- Waterlogging can accelerate cotton leaf and root senescence, increase the number of aborted flowers, squares and bolls and therefore reduce crop yield

However,

No reports on the genetic variation in plant nutrient status under waterlogged conditions in cotton

Many plant species that can tolerate waterlogged conditions contain naturally occurring aerenchyma or develop lysigenous aerenchyma upon waterlogging

At the Central Institute for Cotton Research (ICAR-CICR), Nagpur & its Regional Station Coimbatore, India;

Total seven thousand (7000) *G. hirsutum* germplasm accessions were screened against waterlogging in field conditions and identified 150 Tolerant & Susceptible accessions.

During First Year of evaluation (2012-13); 5000 *G. hirsutum* accessions were screened against waterlogging in field

During 2013-14 second Year of Evaluation :

2000 germplasm *G. hirsutum* accessions were screened against waterlogging

The 45 days old saplings of 150 germplasm accessions selected during previous year were subjected to waterlogging for 70 days continuously.

Then the waterlogged condition was withdrawn and compared with the control plot.

The maturity of the plants in water logged field was delayed by 25 – 30 days as compared to that of the plots in control plot.

Selected 100 plants which showed tolerance to waterlogging

So under the Field Experiment……

7000 *G.hirsutum* germplasm lines were subjected to waterlogging stress in Field Experiment

Forty five days old cotton plants were subjected to water logging stress for continuous 19 days under field condition by maintaining the water level of 15 cm and also by providing irrigation.

The morphological adaptation was found in Tolerant Accessions as hypertrophied lenticels, development of adventitious roots and some accessions developed both lenticels and adventitious roots which is considered as one of adaptive feature in waterlogged tolerant species to overcome transient waterlogged conditions and improved the physiological function of cotton plants.

Amongst short-listed germplasm lines ; they were screened for waterlogging tolerance from previous years study along with identified water logging tolerant and water logging susceptible lines grouped based on presence and absence of lenticels and adventitious roots.

Leaf senescence characters and yield attributing characters were also evaluated with water logging stress. Five plants were taken from each accession and observations on number bolls per plant, boll weight (g), seed cotton yield per plant basis were recorded.

Field Experiments : Cotton plants subjected water logging stress

Waterlogging and Control plot for evaluation of *G. hirsutum* accessions

Adventitious root formed observed after 5-6 days of waterlogging condition in the field condition of few *G.hirsutum* accessions

Lenticels formed observed after 3-5 days of waterloging condition in the field condition of few *G.hirsutum* accessions

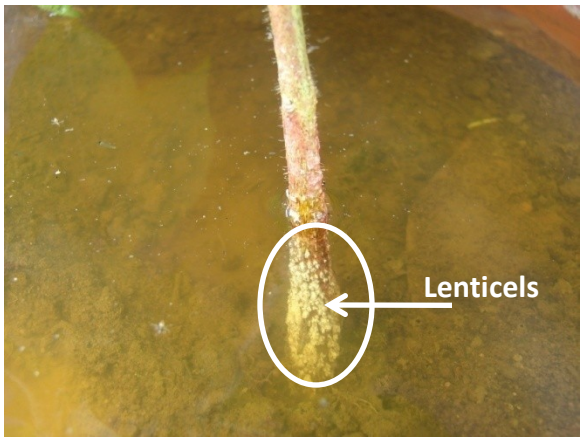
Pot Experiment

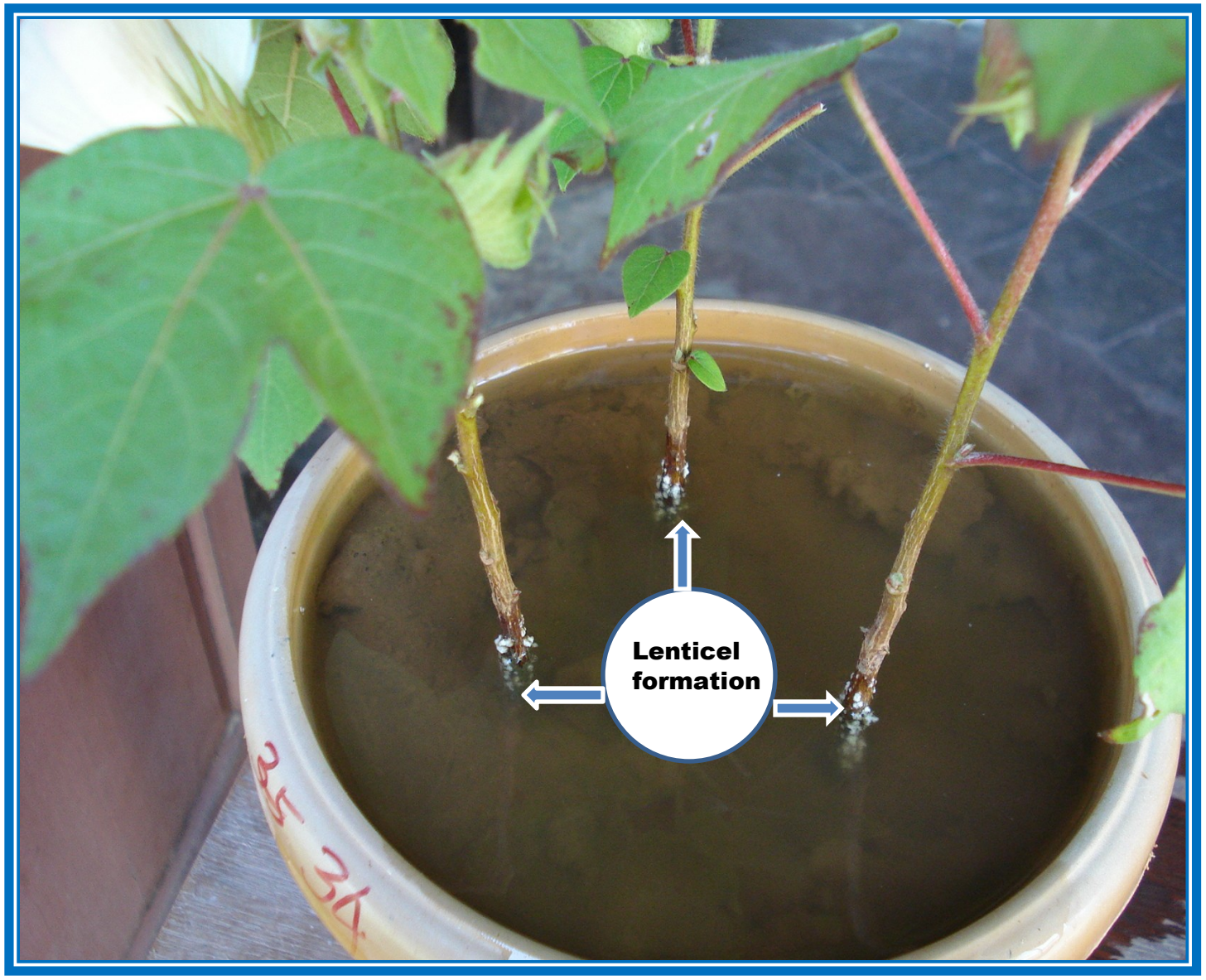
- **Morphological adaptations like Lenticels and adventitious roots were prominently observed in Tolerant accessions in pot culture.**

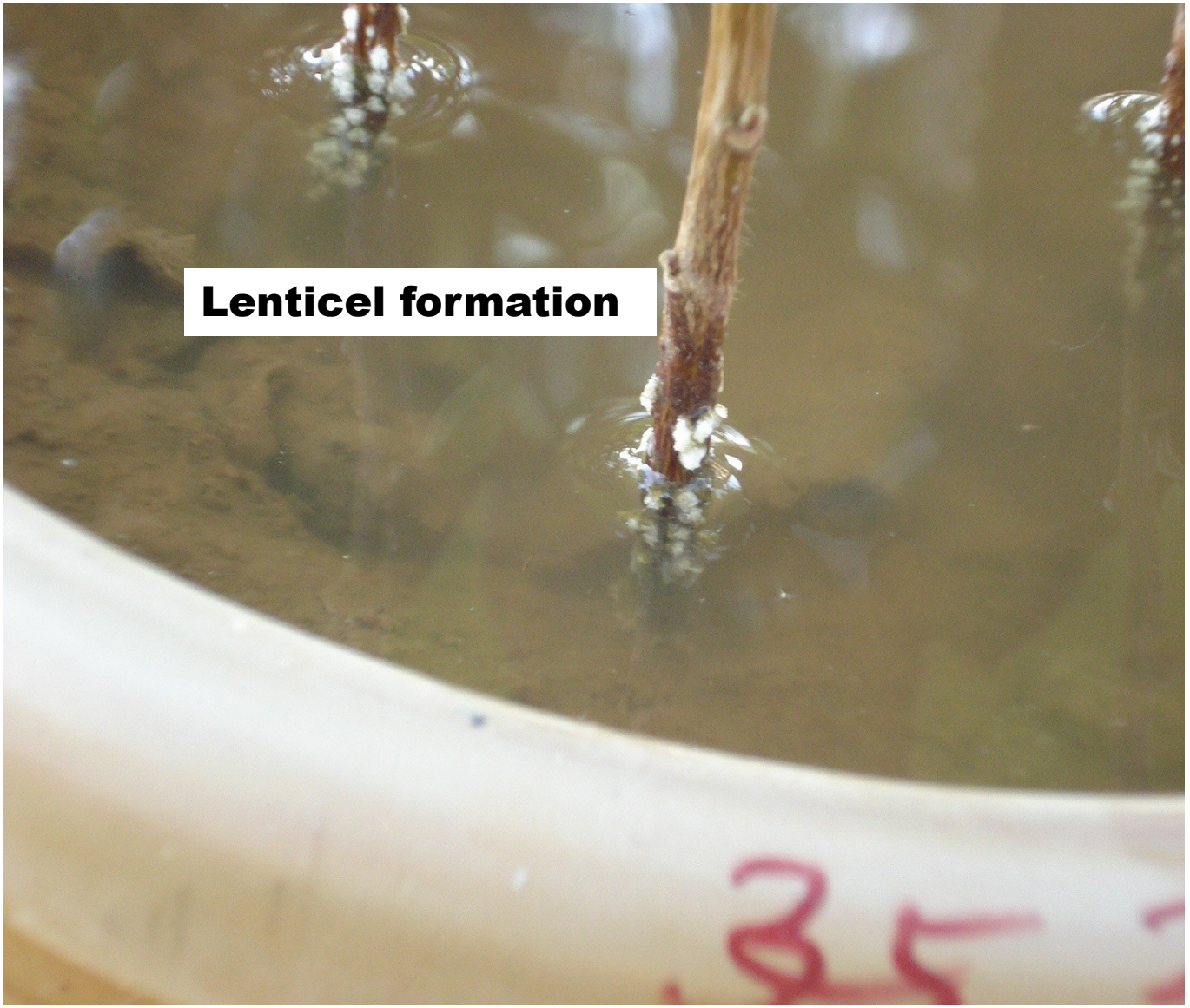
Screening for water logging resistance - (20 days of water logging)

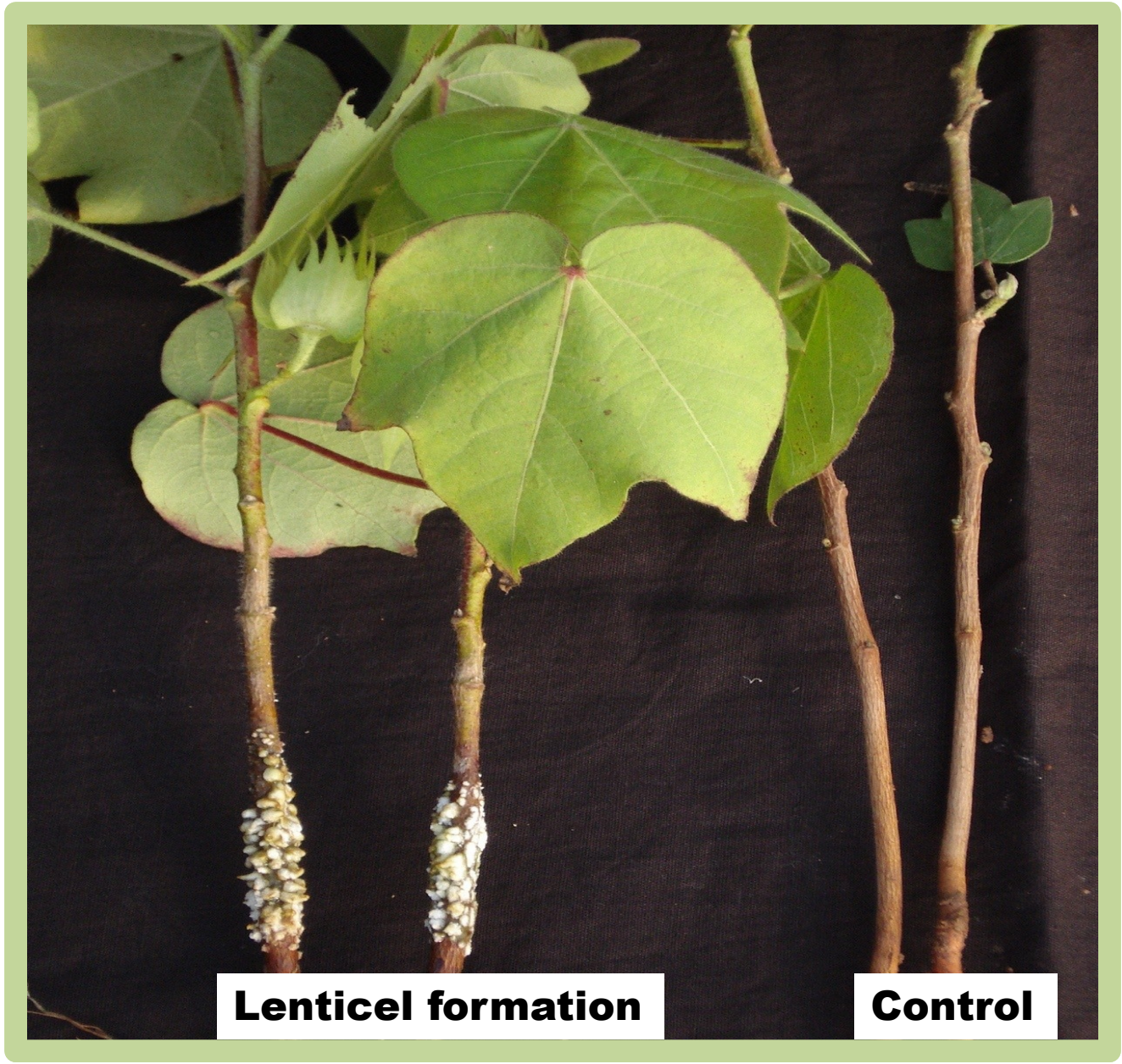
- **Presence of Lenticels was prominent in some tolerant accessions eg IC 359838**

Waterlogging tolerant accession with Lenticels




Lenticel
formation


Lenticel formation


Lenticel formation
Control

Adventitious Roots in Tolerant Accession

IC 357477

IC 359380

Tolerant Genotypes against waterlogging

R I R II R III CONTROL

IC 359941

Lenticels and adventitious roots

Susceptible Genotypes against waterlogging

R I R II R III CONTROL

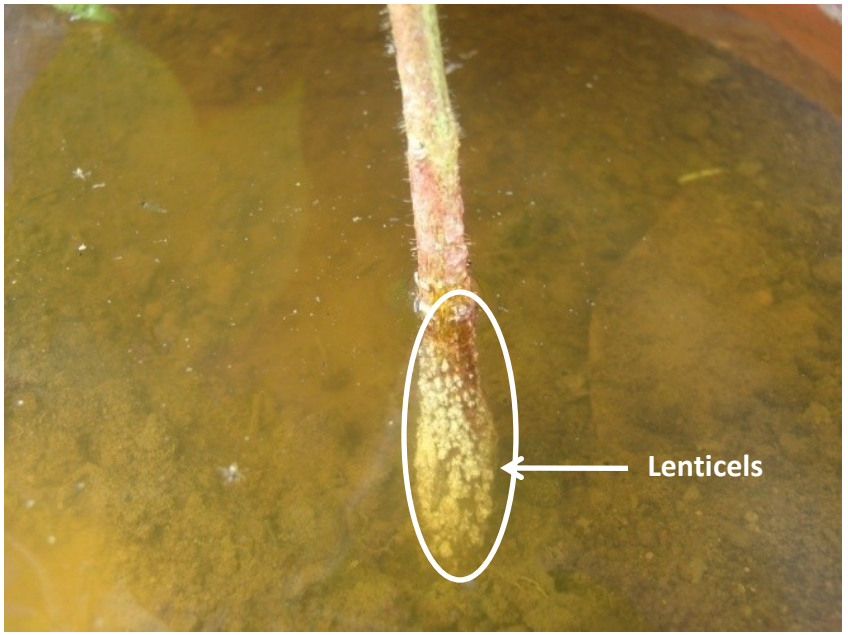
IC 357122

Full lenticel formation by 12th day of water logging

- **Morphological adaptations like Lenticels and adventitious roots were prominently observed in Tolerant accessions in pot culture.**

- **Presence of Lenticels was prominent in some tolerant accessions eg IC 359838**

Waterlogging tolerant accession with Lenticels



Only Lenticels

IC 359726

Screening Criteria

Germplasm accessions were screened based on :

- **General morphological Characters/reflecting growth**
- **SPAD (Soil Plant Analysis Device)values**
- **Timing of formation of Lenticels**
- **Adventitious roots**
- **Iron deficiency**
- **Nitrate Reductase Activity**
- **Yield and Yield components (will be recorded in April as there are still lot of green bolls in the plants)**

(Three plants / germplasm line were taken observations)

Range of different parameters observed in germplasm lines

S.No	Parameter	Range
1	Plant Height	25.0 to 72.7 cm
2	Number of Sympodia	7.0 to 27.0
2	HNR	0.1 to 2.3
4	Number of leaves	14.0 to 115
5	SPAD value	3.3 to 22.7
6	% reduction of SPAD value over Control	26.7 to 89.2
7	Nitrate Reductase (NR) activity	11-170 µg NO_2/ g/hr

Crossing Program

Crosses between identified Waterlogging Tolerant and Suseptible accessions have been initiated.

Iron (Fe) Deficiency

Iron deficiency symptoms started at 5 days after initiation of waterlogging. However few lines did not show Fe deficiency symptoms upto 10 to 15 days after initiation of waterlogging.

Confirmation !!!!!

Iron deficiency symptoms at 5 days after withdrawal of waterlogging. After 20 days most of the germplasm lines recovered from iron deficiency.

Initiated molecular work based on the information about submergence gene tolerance in Rice

Work is in progress……

Thank You !!!!!!!