Water-logging
A Forgotten Problem in Pigeonpea

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The Problem

- Water-logging is emerging as a pressing concern at the backdrop of climate change in recent years
- A global report on climate change has projected a 0.5 – 1.2°C rise in temperatures by 2020, resulting in unpredictable and excessive rain
- Globally, an area of more than 40 million ha is affected by water-logging
- In India, an area of 8.53 million ha is affected by water-logging with an estimated loss of >2 million tons of food grains every year.

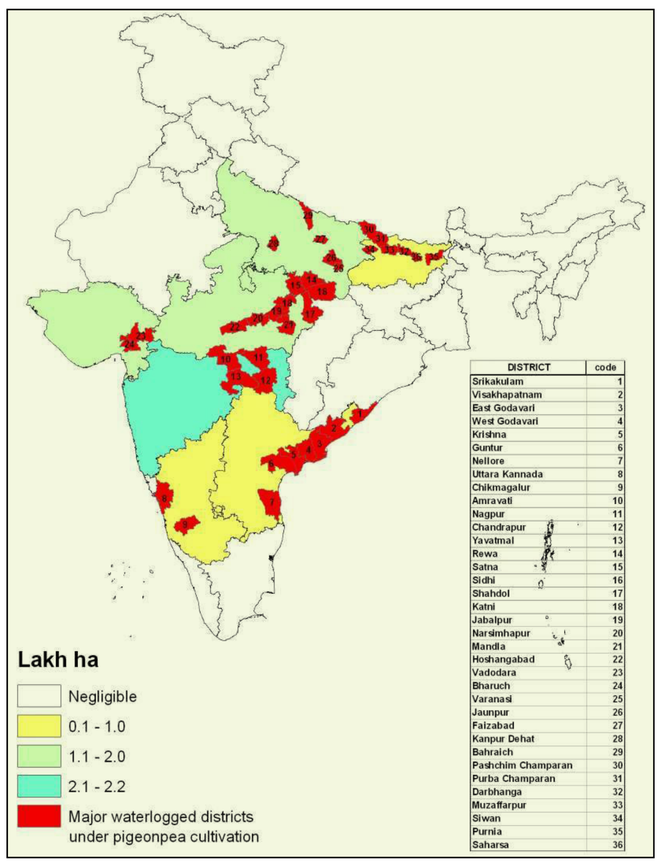
Water-logging and Pigeonpea

- Pigeonpea is mainly grown by resource poor farmers as a rainfed crop in the regions with mean annual rainfall between 600 and 1500 mm
- It has been estimated that more than 30% of the pigeonpea growing areas are prone to water-logging every year
- Water-logging also predisposes pigeonpea plants to Phytophthora blight disease during the rainy season and may result in up to 100% yield losses
- In India alone the annual losses to the crop are estimated at 0.32 m tons, costing about US$ 22 million (Table 1).
- Major water-logging affected areas in India are Bihar, Maharashtra, Madhya Pradesh and Uttar Pradesh, contributing to nearly 58% of the total area and 65% of national pigeonpea production (see India map).

Table 1: State-wise break up of major pigeonpea growing states of India affected by water-logging as assessed in 2006-07.

State	Cultivated pigeonpea area (m ha)	*Water-logged area (m ha)	Estimated annual losses due to water-logging	
			Production (t)	Amount (US$ m)
Maharashtra	1.107	0.22	77000	5.236
Uttar Pradesh	0.383	0.16	56000	3.808
Bihar	0.033	0.026	9100	0.6188
Andhra Pradesh	0.494	0.074	25900	1.7612
Madhya Pradesh	0.322	0.184	64400	4.3792
Gujarat	0.254	0.188	65800	4.4744
Karnataka	0.601	0.061	21350	1.4518
Total	3.194	0.913 (28.15%)	319550	21.7294

*Estimated water-logged area under pigeonpea cultivation in India



The Potential Solutions

- Breeding water-logging tolerant varieties is the most viable solution that could be available to resource poor farming communities.
- Utilization of the available genetic resources and focused research initiatives are needed to address the problem of water-logging.
- Incorporation of genetic resistance to Phytophthora blight disease in water-logging tolerant high yielding pigeonpea cultivars will be essential for a long term solution.

The Potential Screening Techniques

Seed level screening

Seeds of pigeonpea genotypes with wide genetic background were screened for water-logging tolerance by assessing their germination and survival rate after 192 h of water-submergence treatments under laboratory at 25-30°C (Fig 1).

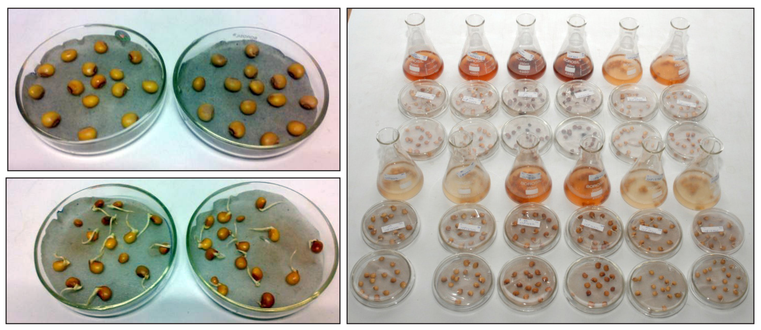


Fig 1: Screening for tolerance to water-submergence at seed level under laboratory condition.

Seedling level screening

The pigeonpea genotypes selected after seed level screening were further grown in pots filled with black soils and stress treatment was given to 15-day old seedlings by submerging the pots in a tray filled with water for 20 days (Fig 2).

Fig 2: Screening for tolerance to flooding at seedling level under glass house condition.

Pot screening at early vegetative stage

The pigeonpea genotypes survived after seed and seedling level treatment were further sown in pots with perforations at their base. Stress treatment was given by submerging the pots under artificially created ponds for 8 days when the plants were 40 days old (Fig 3).

Fig 3: Screening for tolerance to flooding at seedling level under artificially created pond.

Field Screening

All the selected genotypes identified through pot screening were screened to identify their responses to artificially water-logged field conditions (Fig 4).

Fig 4. Screening of pigeonpea germplasm under field at ICRISAT, Patancheru.

Water-logging Tolerant Genotypes Identified (Table 2)

Table 2: Groups of pigeonpea genotypes classified into tolerant on the basis of germination rates after 0, 120, 144, 168 and 192 h submergence treatments, where MD= medium duration and, SD= short duration

Genotype	Maturity duration	Mean germination ASIN transformed (percent)				
		0 h	120 h	144 h	168 h	192h
Hybrids						
ICPH 3992	MD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)
ICPH 4187	MD	5.3 (100.0)	5.3 (100.0)	5.2 (90.0)	5.3 (100.0)	5.2 (90.0)
ICPH 3740	SD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.2 (93.3)	5.0 (76.7)
ICPH 2431	SD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)
Varieties						
Mal-15	MD	5.3 (100.0)	5.3 (100.0)	5.3 (96.7)	5.3 (96.7)	5.1 (83.3)
LRG-30	MD	5.3 (100.0)	5.2 (93.3)	5.3 (96.7)	5.3 (100.0)	5.2 (93.3)
ASHA	MD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.2 (93.3)	5.2 (86.7)
Elite inbred lines						
ICPL 20122	MD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)
ICPL 92043	SD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)
ICPL 99054	MD	5.3 (100.0)	5.3 (100.0)	5.3 (96.7)	5.2 (90.0)	5.2 (90.0)
ICPL 20238	SD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100)	5.2(86.7)
Germplasm						
ICP 7193	MD	5.3 (100.0)	5.3 (100.0)	5.3 (96.7)	5.3 (100.0)	5.3 (96.7)
ICP13379	MD	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)	5.3 (100.0)
ICP 7977	MD	5.3 (100.0)	5.2 (95.0)	5.3 (100.0)	5.2 (93.3)	5.3 (100.0)
ICP 14085	MD	5.3 (100.0)	5.3 (100.0)	5.3 (96.7)	5.3 (100.0)	5.2 (90.0)

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