Abiotic stress tolerant maize for increasing income and food security among the poor in eastern India and Bangladesh

International Maize and Wheat Improvement Center (CIMMYT)

Country/Region:	India and Bangladesh
German participation	University of Hohenheim
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Duration:	Jan 2008 – Dec 2010

Initial situation

In South and South-East Asia more than 80% of maize is grown under rain-fed conditions. High climatic variability limits the adoption of maize and its yield, as the plants are exposed to water-logging and drought, often in the same field. The expanding private maize seed sector focuses on the development of full-season varieties with high yield potential under irrigation, while varieties tolerant to water stress are not being produced. Due to the risk of maize production, farmers decrease the use of other input factors, such as fertilizers, which depresses productivity even further. This project aims at developing normal and quality protein maize (QPM) tolerant to excess and deficit water conditions, enforcing the dissemination of these varieties, improving returns to investment in inputs, and supporting improved value chains. The project builds upon previous gains in stress tolerance and QPM breeding to address the persistent problem of poverty due to low productivity in rain-fed farming.

Approach of the project

The breeding approach, following backcross breeding, is based on existing sources for drought and water-logging tolerance and on rapid selection gains during multiple seasons per year. Different target environments and their correlation will be used in order to maximize selection response and to reduce genotype x environment interaction (GEI) effects. GEI analysis will be linked to Geographic Information System (GIS) data and used to map potential deployment areas in Eastern India, Bangladesh and similar zones in S&SE Asia. Zero- and reduced-tillage systems are being optimized for faster maize establishment in wet soils after rice, while biophysical and socioeconomic assessment will identify areas suitable for maize expansion. Information from participatory interaction with stakeholders will be used to develop recommendations for improving the usefulness, availability, and access to the newly-bred varieties and enhanced crop management methods to farmers. National program and private sector scientists will receive training in breeding methods and strategies that are appropriate for target environments affected by water-logging and drought.

Major results achieved

Annual review and planning meetings of the project partners and stakeholders from Eastern India and Bangladesh revealed the vulnerable situation of rain-fed maize production. According to the project action plan, existing commercial hybrids from both public and private sector (112 cultivars) were evaluated under managed drought and water-logging stress. The top-ranking cultivars were then identified for participatory variety selection (PVS) trials in the target environment in India and Bangladesh. The performance of elite lines was re-validated under managed drought and water-logging stress, and potential recurrent and donor parents were selected and used for crossing. Populations with water-logging tolerances are mapped by phenotype; genotyping is then done using single nucleotide polymorphism (SNPs).

Moreover, a single-seed maize planter has been developed for zero-tillage planting; it is currently in process of fine-tuning and testing on zero-till wet rice fields. Two training courses for the multi-disciplinary research team were realised, one each in India and Bangladesh.

Expected impact

The expected impact of the project is an improved food security and income situation of consumers and maize-farming families in Eastern India and Bangladesh. This is to be achieved by providing farmers with stress tolerant maize varieties and associated management technologies, offering crop diversification and intensification options. Greater yields under drought and water-logging and an improved nutritional value of food and livestock feed due to the use of stress tolerant QPM are the expected results of this strategy.

Specific outputs include:

- Water-logging and drought-tolerant normal and QPM varieties and associated management technologies developed
- Genes enhancing water-logging tolerance mapped
- Efficient strategies for environments with high water variability selected, and potential target environments for project varieties localised
- Biophysical and socio-economic constraints and opportunities for expansion of maize production in India and Bangladesh assessed
- Capacity of South Asian breeding programs and local seed companies strengthened in order to serve stressful maize production environments

Collaborating institutions: Directorate of Maize Research, New Delhi, India; M.P. Agriculture University, Udaipur, India; Rajendra Agriculture University (RAU), Bihar, India; Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh

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