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## e-News

### **“HHB 67-Improved”- The first product of marker-assisted crop breeding in India**

Pearl Millet (*Pennisetum glaucum*) is grown for grain and stover in the hottest and driest areas of Asia and Africa where dryland and rainfed crop production occurs. In India, 70% or more of the 9 million hectares of this crop is sown to genetically uniform single-cross hybrids. However, most single-cross hybrids are particularly vulnerable to downy mildew (DM) disease, caused by *Sclerospora graminicola* (a close relative of the plant pathogen responsible for the Great Potato Famine in Ireland in the 1840s). DM is the most devastating disease of pearl millet in Asia and Africa, causing up to 30% production losses in India during epidemic years.



*Bountiful harvest of “HHB-67 Improved” in farmer’s field*

HHB 67, released in 1990 through the All India Coordinated Pearl Millet Improvement Project (AICPMIP) of the Indian Council of Agricultural Research (ICAR) is a highly popular single-cross pearl millet hybrid grown on over 500,000 ha in Haryana and Rajasthan. It is extra-early, requiring less than 65 days from sowing to grain maturity. Recent surveys have, however, indicated that HHB 67 has started to succumb to DM, showing up to 30% disease incidence in farmers’ fields.

### **Development of a more downy mildew resistant HHB 67**

ICAR in partnership with the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) adopted marker-assisted selection technology to accelerate the incorporation of additional DM resistance into the background of popular hybrid HHB 67. The parental lines of HHB 67 were subjected to DM resistance maintenance breeding. Restriction fragment length polymorphism-based marker-assisted backcrossing with elite donor parent ICMP 451 was used to add DM resistance to male parent H 77/833-2. The result was several improved resistant versions of H 77/833-2. Additional genes for DM resistance were backcrossed into female parent 843A/B from donor ICML 22 using conventional progeny-based greenhouse disease screening of pot-grown seedlings. Conventional backcross transfer of DM resistance to improve 843A/B took nearly nine years (1991-1999), while marker-assisted backcross transfer of DM resistance to improve H 77/833-2 was completed in just over three years (1997-2000).

### **Testing**

Greenhouse disease screening confirmed the improved DM resistance of the new versions of the parental lines and their hybrids. Hybrids were tested across six sites in India in collaborative trials conducted during the 2001 rainy season. Two of the improved versions of HHB 67 were subsequently compared for agronomic performance with the original HHB 67 during three years (2002–2004) of on-station state trials in Haryana, on-station national trials of the AICPMIP, and more than 100 on-farm trials conducted in several districts of Haryana where HHB 67 had become the most popular pearl millet cultivar over the previous 15 years. During these trials, farmers expressed a clear preference for one of the two improved hybrids, which is slightly taller (15–30 cm), later maturing (2–3 days), and has higher grain and stover yields (5–10%) than the original HHB 67, besides being more resistant to DM.

## Release

After three years of testing in national trials, the Haryana State Varietal Release Committee on 14 Jan 2005 approved the release of this improved version of hybrid HHB 67 for cultivation in Haryana. This hybrid, "HHB 67-Improved", was approved by the ICAR Central Plant Variety Release Committee on 29 June 2005, and the same was released at All India level in July 2005.

## Priming the seed multiplication pipeline

Large quantities of breeder seed of the parental lines of "HHB 67-Improved" were distributed by ICRISAT and CCS Haryana Agricultural University in 2005-06 to public and private seed agencies, which could ensure sowing of more than 50,000 hectares with Certified Hybrid Seed of "HHB 67-Improved" during the 2006 rainy season. Further parental line seed multiplication during 2006/07 will ensure that "HHB 67-Improved" swiftly replaces HHB 67, before downy mildew inoculum levels build up to cause an economically-devastating epidemic.

## Economic Benefits

In years of severe DM attack, up to 30% of the pearl millet grain and straw harvest can be lost. By adopting hybrid "HHB 67-Improved", farmers in the two states of Haryana and Rajasthan will avoid grain production losses of at least Rs 36 crores (US\$8 million), which would be expected in the first year of a major DM outbreak on HHB 67. The value of potential grain yield losses in one year of a major DM epidemic exceeds the total research funding utilized during the period 1990 through 2005 for developing "HHB 67-Improved". Benefits from avoidance of grain and stover yield losses in the subsequent years of DM epidemic will represent profits to society accrued from the collaborative research integrating modern biotechnology with conventional breeding.

### HHB 67-Improved

- **The first product of marker assisted breeding to be delivered to Indian farmers.**
- **The first product of high-tech collaboration between Indian Council of Agricultural Research and International Crops Research Institute for Semi-Arid Tropics.**
- **Among the first public-bred marker-assisted breeding products commercialized in developing countries.**

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