

Farmers there grow chilies and sunflower during the rainy season and produce pearl millet hybrid seed under irrigation in the summer. Across the state, 1055 ha of certified hybrid seed of HHB 67 Improved



Hybrid seeds are not only beneficial to farmers, but to seed producers and the seed industry as well.

was produced in 2008, and approximately 120 trucks (10 t each, enough to sow 2500 to 3300 ha per truck) of its seed was dispatched to Rajasthan and Haryana for rainy season sowings. The Rajasthan State Seed Corporation has placed orders for 800,000 kg of seed for rainy season delivery, enough to sow 200,000 ha. It is currently estimated that certified hybrid seed multiplication of HHB 67 Improved is underway on 2200 ha in Andhra Pradesh during 2009.

Since its release in 2005, over 3 t of Breeder Seed of the parents of HHB 67 Improved (1031 kg of pollinator, 1729 kg male-sterile line, and 255 kg maintainer line) has been supplied by ICRISAT to seed producers. Initially this was used primarily for direct multiplication of Certified Seed of the hybrid, but now it is primarily used for Foundation Seed production of the hybrid parental lines themselves.

With large areas under HHB 67 Improved seed production in 2009 we expect that over 700,000 ha in Haryana and Rajasthan could be sown with this hybrid during the 2009 rainy season, benefiting hundreds of thousands of farm families.

# Pearl Millet Hybrid "HHB 67 Improved"

*Developed using MAS, resists downy mildew,  
saves millions in crop losses*



## About ICRISAT



Science with a human face

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 644 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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## Introduction

Pearl millet (*Pennisetum glaucum*) is grown for grain and stover in the hottest and driest areas of Africa and south Asia. In India, at least 70% of the 9 m ha sown to this crop is genetically uniform single-cross hybrids, which are particularly vulnerable to downy mildew (DM) disease caused by the pseudo-fungus *Sclerospora graminicola*. DM is the most important pearl millet disease, causing national production losses up to 30% during epidemics.

An old hybrid, HHB 67 released in 1990 by CCS Haryana Agricultural University (HAU), India, is one such single-cross pearl millet hybrid. It is highly popular because of its extra-early maturity (65 days from sowing to grain maturity) and in the late 1990s was grown on hundreds of thousands of hectares in Haryana and Rajasthan states. Unfortunately, recent surveys (2007) indicated that this hybrid now develops up to 30% incidence of DM in farmers' fields.

## Development

HHB 67 was rapidly and widely adopted by farmers during the early 1990s, so its parental lines were chosen for DM resistance maintenance breeding in an attempt to break the boom-bust cycles that have characterized pearl millet hybrid cultivation in India since the late 1960s. Marker-assisted backcrossing with elite donor parent ICMP 451 was used to add DM resistance to male parent H 77/833-2. Marker-assisted selection (MAS) used restriction fragment length



Hybrid seed production provides cash income to pay school fees and other family expenses.



Before downy mildew caught up with it, farmers were very happy with the original HHB 67.

polymorphism, which is considered too slow, too cumbersome, and too expensive to use in applied selection. However, the challenge was taken up by HAU and ICRISAT. Additional DM resistance genes were backcrossed into female parent 843A/B from donor ICML 22 using conventional progeny-based greenhouse 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 to improve H77/833-2 was completed in just over three (1997-2000).

## Testing

Greenhouse disease screening and subsequent field testing across six sites confirmed DM resistance improvement in the new parental lines and their hybrids. Two improved versions of HHB 67 were subsequently compared with the original for agronomic performance in three years (2002-2004) of on-station state trials in Haryana, on-station national trials of the All-India Coordinated Pearl Millet Improvement Project, and >100 on-farm trials conducted in several districts of Haryana where HHB 67 had become the most popular pearl millet cultivar. Farmers expressed a clear preference for one of the two improved hybrids, which is slightly taller (15-30 cm), later (2-3 days), and has higher grain and stover yields (5-10%) than the original HHB 67, as well as being more resistant to DM and having easily recognizable long, thin panicles with short bristles.



The original HHB 67 is still productive but now susceptible to downy mildew Disease.

## Release

After three years testing in national trials, the Haryana State Varietal Release Committee in January 2005 approved release of this improved version for cultivation in Haryana. Its State Release as HHB 67 Improved was approved by the Central Plant Variety Release Committee in June 2005, and this was quickly followed in July of the same year by approval of its All-India Release.

HHB 67 Improved is the first product of marker-assisted breeding to reach cereal producers in India. It is also among the first public-bred marker-assisted breeding products commercialized in developing countries globally, following the 2001 release in Indonesia of rice varieties bred by this technique.

## Economic Benefits

By rapidly adopting HHB 67 Improved, farmers in Haryana and Rajasthan can avoid grain production losses of Rs 36 crores (US\$8 million), which would be expected in the first year of a major DM outbreak on the original HHB 67. In years of severe DM attack, up to 30% of the pearl millet grain and straw harvest can be lost. Income losses in a severe DM outbreak on HHB 67 can be estimated conservatively assuming an average grain yield of 800 kg per ha (the Haryana state average is in excess of 1000 kg per ha), a total area of 500,000 ha,

and a minimum selling price of Rs 3 per kg (prices range from Rs 2 to Rs 7 per kg).

## Increasing and Multiplying

Its good performance, and higher downy mildew disease incidence compared to the original HHB 67, has stimulated large demand for seed of HHB 67 Improved, and both public- and private-sector seed producers are now engaged in meeting this.

Andhra Pradesh state in southern India is famous for pearl millet hybrid seed production. Each summer, farmers in Nizamabad district produce >70% of the country's pearl millet hybrid seed requirement, with annual profits estimated at US\$8 million. Farmers earn net profits of Rs 9,000-10,000 (about US\$250) per acre through this activity.

In 2008, large-scale seed production of HHB 67 Improved was taken up in Nizamabad and Kurnool districts of Andhra Pradesh. Naveen Seeds of Adoni, took up seed production on 210 acres in Gajja Halli village in Holagunda mandal of Kurnool district.



HHB 67 Improved performs superbly in areas where the original HHB 67 was popular.