DMH-1, the first mustard hybrid in India
based on a novel CMS-restorer system

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Development of hybrid varieties through exploitation of heterosis has enhanced productivity in many crop plants (reviewed by Havey, 2004). *Brassica juncea* (oilseed mustard), a major oilseed crop of the Indian subcontinent, has two divergent gene pools (Indian and east European). Single cross hybrids between the lines of the two gene pools are significantly heterotic for yield (Pradhan et al. 1993; Srivastava et al. 2000). However, hybrid seed production at commercial scale has been a major challenge in this crop due to non-availability of proper pollination control mechanism such as male sterility and restorer systems. We report here the development of a hybrid in mustard, named DMH-1, based on a novel CMS-restorer system which is highly amenable to commercial hybrid seed production.

The CMS, designated as '126-1' (Sodhi et al. 2006) was initially identified as a spontaneous occurrence in a doubled haploid population of a resynthesized *B. napus* line. The CMS was found to be stable through many successive generations of backcrossing in *B. napus*. This CMS was transferred to *B. juncea* through conventional backcross breeding. It took about 4 to 7 generations of backcrossing to achieve stable expression of male sterility trait in the recipient varieties of *B. juncea*; the number of backcrosses required for stable male sterility being variable for different varieties. On repeated backcrossing a large number of Indian and east European varieties were found to act as maintainers. It was also observed that any variety other than the one that is male sterile cytoplasm could act as a restorer of this CMS. Thus, the most unique feature of this CMS is that any variety can act as either a maintainer or a restorer; thereby making it the most flexible and amenable system for hybrid seed production in *B. juncea*. CMS '126-1' did not cause any aberrations in either floral or vegetative features. Flower development, flower opening, nectar development were observed to be normal in the CMS plants. The anthers were reduced to small, white translucent structures. There was no

reduction in female fertility and the bee activity during peak flowering season was recorded to be normal. The uniqueness of '126-1' cytoplasm at the molecular level was established through DNA finger printing of mitochondrial DNA.

DMH-1, the '126-1' CMS based hybrid, was developed between Indian cultivar Pusa bold and a canola quality east European line, EH-2. DMH-1 is taller than Indian varieties (~200cm), has high number of primary and secondary branches which bear a large number of pods, a character inherited from the east European parent. Tip sterility of the inflorescence is negligible. The pods are thin walled and on an average contain ~15 seed each with a test weight of about 4.1gm. It matures about 7-10 days earlier than major Indian varieties. The oil content of DMH-1 is ~40%.

During the past two years this hybrid has been put for extensive farmers' field demonstration trials in the north and northwestern mustard-growing belt of India. The farmers field demonstration trials were conducted in approximately 4000m^2 plot each for DHM-1 and check varieties. Average heterosis of 35.6% was recorded in 2004-05 and 28.5% in 2005-06. The results of farmers field demonstration trials have been shown in Table 1. Besides monitored trials, DMH-1 was grown in about 496 acres of land during 2005-06 where the farmers were provided the seed and suggested a broad package of practices. An average yield heterosis of 18% was recorded from these trials. Maximum yield potential of the DMH-1 hybrid was recorded as 3.29 tonnes/hectare in the field demonstration trials and 3.78 tonnes/ hectare in the minikit trials. The hybrids were found to be highly resistant to white rust and significantly tolerant to alternaria blight in comparison to widely grown cultivars of mustard in India.

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Table 1. Average yield performance of DMH-1 in multi-site farmers' field demonstration trials conducted for two years

	2004-05				2005-06			
Locations	Number of trials	Yield kg/ha		% heterosis	Number of trials	Yield kg/ha		% heterosis
		Check	DMH-1			Check	DMH-1	
Bharatpur (Rajasthan)	4	1522	2054	35	6	2285	2915	27
Agra (UP)	4	2127	2568	21	4	2027	2515	24
Rewari (Haryana)	2	1759	2654	51	4	2040	2425	19
Alwar (Rajasthan)	-	-			4	1985	2515	27
Morena (MP)	-	-			4	2070	2675	29
Sri Ganganagar (Rajasthan)	-	-			5	1775	2570	45