



UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, D.C.

AND

NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA STATE UNIVERSITY
FARGO, ND

**NOTICE OF RELEASE OF HA-DM2, HA-DM3, and HA-DM4, CONFECTION
SUNFLOWER**

Downy mildew caused by *Plasmopara halstedii* and rust caused by *Puccinia helianthi* are two fungal diseases that are major yield limiting factors in global sunflower production. Confection sunflower is more vulnerable to downy mildew and rust than oilseed sunflower due to the lack of resistance sources. Three sunflower (*Helianthus annuus* L.) confection germplasms, HA-DM2, HA-DM3, and HA-DM4 have been developed to provide diversity for resistance to downy mildew and rust. HA-DM2, HA-DM3, and HA-DM4 represent the first confection germplasm with combined resistance to both downy mildew and rust.

HA-DM2 is a BC4F3-derived BC4F4 confection restorer selection from the cross of CONFSCLR5*5/RHA 464. CONFSCLR5 is a confection BC1F3-derived BC1F4 restorer selection from the cross of RO12-13//RHA 274/Dobritch/3/PSC 8/4/CONF/5/CONF released by USDA-ARS and the North Dakota Agricultural Experiment Station in 2006. CONFSCLR5 is susceptible to downy mildew and rust infection. RHA 464 (PI 665015) is an oilseed restorer line released by USDA-ARS and the North Dakota Agricultural Experiment Station in 2010 and is resistant to all North America downy mildew and rust races identified so far. The downy mildew and rust resistance genes in RHA 464 were named PIArg and R12 and mapped to linkage groups (LGs) 1 and 11 of the sunflower genome, respectively. HA-DM2 was developed by the backcross and pedigree breeding methods, with selection in each generation for downy mildew and rust resistance. In the BC4F2 generation, DNA markers linked to PIArg and R12, respectively, were used to select the homozygous BC4F2 individuals combining the two R-genes of PIArg and R12, with the selected homozygous double-resistant BC4F2 plants advanced to BC4F3 generation. Downy mildew and rust tests of the selected BC4F3 families in the greenhouse confirmed their homozygous nature. The homozygous BC4F3 seeds were grown in 16 rows of 20 plants at Glyndon, MN, in 2016, and the harvested BC4F4 seeds were bulked to form HA-DM2.

HA-DM3 is a BC4F3-derived BC4F4 confection maintainer selection from the cross of HA-R6*5/HA 458. HA-R6 (PI 607509) is a confection maintainer line released by USDA-ARS and the North Dakota Agricultural Experiment Station in 2001 resistant to all North America (NA) rust races identified so far. The rust resistance gene (R-gene) in HA-R6 was named R13a and mapped to LG13

of the sunflower genome. HA 458 (PI 655009) is an oilseed maintainer line released by USDA-ARS and the North Dakota Agricultural Experiment Station in 2010 resistant to all NA downy mildew races identified so far. The downy mildew resistance gene in HA 458 was named P117 and mapped to LG4 of the sunflower genome. HA-DM3 was developed by the backcross and pedigree breeding methods, with selection in each generation for downy mildew resistance. In the BC4F2 generation, DNA markers linked to P117 and R13a, respectively, were used to select the homozygous BC4F2 individuals combining the two R-genes of P117 and R13a, with the selected homozygous double-resistant BC4F2 plants advanced to BC4F3 generation. Downy mildew and rust tests of the selected BC4F3 families in the greenhouse confirmed their homozygous nature. The homozygous BC4F3 seeds were grown in 16 rows of 20 plants at Glyndon, MN, in 2016, and the harvested BC4F4 seeds were bulked to form HA-DM3.

HA-DM4 is a BC4F3-derived BC4F4 confection maintainer selection from the cross of HA-R6*5/HA-DM1. HA-R6 is described above. HA-DM1 (PI 674793) is an oilseed maintainer line released by USDA-ARS and the North Dakota Agricultural Experiment Station in 2015 and is resistant to all NA downy mildew races identified so far. The downy mildew resistance gene in HA-DM1 was named P118 and mapped to LG2 of the sunflower genome. HA-DM4 was developed by the backcross and pedigree breeding methods, with selection in each generation for downy mildew resistance. In the BC4F2 generation, DNA markers linked to P118 and R13a, respectively, were used to select the homozygous BC4F2 individuals combining the two R-genes of P118 and R13a, with the selected homozygous double-resistant BC4F2 plants advanced to BC4F3 generation. Downy mildew and rust tests of the selected BC4F3 families in the greenhouse confirmed their homozygous nature. The homozygous BC4F3 seeds were grown in the greenhouse, and the harvested BC4F4 seeds were bulked to form HA-DM4.

Small quantities of seed of the HA-DM2, HA-DM3, and HA-DM4 germplasms will be available from the North Dakota Foundation Seedstocks Project, Department of Plant Sciences, NDSU Dep. 7670, P.O. Box 6050, Fargo, ND 58108-6050. Seed of this release will also be deposited in the USDA National Plant Germplasm System, where it will be available for research purposes, including development and commercialization of new cultivars. U.S. Plant Variety Protection will not be pursued for HA-DM2, HA-DM3, and HA-DM4.

ARS GIVES NO WARRANTIES OR GUARANTEES, EXPRESSED OR IMPLIED FOR THE MATERIAL, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Signatures:



Vice President for Agricultural Affairs
North Dakota State University

5/30/17
Date



Deputy Administrator, Crop Production and Protection
Agricultural Research Service, U.S. Department of Agriculture

6/13/17
Date