



UNITED STATES DEPARTMENT OF AGRICULTURE
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RELEASE OF OILSEED SUNFLOWER LINES RESISTANT TO DOWNY MILDEW

Downy mildew (DM), caused by the oomycete *Plasmopara halstedii*, is known as the most prevalent disease occurring in the global sunflower production areas, especially in North America and Europe. As a soilborne disease, *P. halstedii* oospores infect sunflower plants in the early growth stages leading to significant yield losses of more than 90 % in susceptible hybrids when weather conditions are favorable for infection. The use of DM resistant hybrids is considered to be the best option to control DM disease. Sunflower resistance to DM can be based on major, race-specific resistance genes (*R* genes), designated as *Pl* genes. HA-DM15 and HA-DM16 were developed by introgressing the new *Pl* genes from wild annual sunflower species *Helianthus annuus* and *H. praecox*, respectively, into cultivated oilseed sunflower, providing new sources for use in sunflower DM resistance breeding.

HA-DM15 (*Pl₃₇Pl₃₇*) is a BC₁F₃-derived BC₁F₄ oilseed maintainer selection from the cross of HA 89//NMS HA 89/*Helianthus annuus* accession PI 435417 developed for resistance to DM. HA 89 (PI 599773) is an oilseed maintainer line susceptible to DM released by USDA and the Texas Agricultural Experiment Station in 1971, while the nuclear male sterile (NMS) HA 89 is a mutation of HA 89, genetically similar to HA 89, but possessing a single recessive male sterile gene *ms9* released by USDA in 1990. The wild *H. annuus* accession (PI 435417) originally collected in Texas in 1976 was identified as resistant to new *P. halstedii* races in 2005. HA-DM15 was developed using the backcross breeding method and DNA marker-assisted selection for the *Pl₃₇* gene introgressed from wild *H. annuus* accession PI 435417. The cross between NMS HA 89 and PI 435417 was initially made in 2015 and the selected resistant F₁ plants were backcrossed to HA 89. In the BC₁F₃ population with 140 families, three homozygous families with good seed set were selected based on DM tests using *P. halstedii* race 734 and DNA markers linked to the *Pl₃₇* gene mapped to sunflower chromosome 4. The BC₁F₃-derived HA-DM15 is homozygous for the *Pl₃₇* gene verified by DNA markers and immune to *P. halstedii* races, 700, 707, 714, 730, 734, 770, and 776 which are currently identified as the most prevalent and virulent races in the United States and Europe. Plant height of HA-DM15 was 171 cm compared to 135 cm for HA 89 and flowered in 70 days after planting compared to 68 days for HA 89 in the field nursery at Glyndon, MN during the summer of 2021.

HA-DM16 (*Pl₃₈Pl₃₈*) is an improved oilseed derivative of Rf PRA-417 (PI 596749) with resistance to DM. Rf PRA-417 is a BC₁F₂ bulk from an interspecific cross of cytoplasmic male sterile (CMS) HA 89*2/PRA-417 released as a male fertility restorer line in 1991. The CMS HA 89 was developed by substituting the nuclear genome of HA 89 into the background of a wild annual species *H. petiolaris* (CMS PET1). PRA-417 is a wild *H. praecox* subsp. *runyonii* accession. Initial DM screening with *P. halstedii* race 734 revealed that Rf PRA-417 was

segregating for DM infection. Six resistant plants from the Rf PRA-417 population of 58 plants tested were selected and self-pollinated to the next generation. The progeny tests of the selected plants revealed that three, 19-06-3, 19-06-4, and 19-06-5 (BC₁F₃) were homozygously resistant to DM infection. The DM R gene *Pl₃₈* from the wild *H. praecox* PRA-417 has been genetically mapped to sunflower chromosome 2. The BC₁F₃-derived HA-DM16 is homozygous for the *Pl₃₈* gene verified by DNA markers and immune to the most prevalent and virulent *P. halstedii* races, 700, 707, 714, 730, 734, 770, and 776. Plant height of HA-DM16 was 158 cm compared to 135 cm for HA 89 and flowered in 68 days after planting the same as HA 89 in the field nursery at Glyndon, MN during the summer of 2021.

Small quantities of seed of the HA-DM15 and HA-DM16 germplasm lines 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 they will be available for research purposes, including development and commercialization of new cultivars. U.S. Plant Variety Protection will not be pursued for HA-DM15 and HA-DM16.

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Signatures:

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

Date