UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Services
Washington, D.C.

and

NORTH DAKOTA STATE UNIVERSITY
North Dakota Agricultural Experiment Station
Fargo, ND

NOTICE OF RELEASE OF TWO CONFECTION SUNFLOWER MAINTAINER AND RESTORER LINES

Rust incited by the fungus *Puccinia helianthi* and downy mildew (DM) incited by the obligate pathogen *Plasmopara halstedii* are two of the most globally important sunflower diseases causing significant yield losses and reduced seed quality. Resistance to rust and DM is controlled by race-specific single dominant genes. Confection sunflower is more vulnerable to rust than oilseed sunflower due to a lack of resistance sources. Of the 17 rust resistance genes (*R* genes) reported in sunflower, only five are present in confection sunflower. To avoid the large-scale use of single race specific gene(s) resulting in the breakdown of resistance, pyramiding of more than one resistance gene in a single genotype is expected to considerably extend the durability and longevity of the resistance genes. HA-R20 and HA-R21 were developed to pyramid different rust *R* genes and DM *R* genes, providing multiple and durable resistance to both rust and DM.

HA-R20 is a F3-derived F4 restorer selection from the cross of HA-DM2 and HA-R8. HA-DM2 (PI 687022) is a confection restorer line resistant to rust and DM released by USDA Sunflower and Biology Research Unit and the North Dakota Agricultural Experiment Station in 2017. HADM2 harbors the *R12* rust gene and DM *PlArg* gene mapped to linkage groups (LGs) 11 and 1 of the sunflower genome, respectively. HA-R8 (PI 607511) is an oilseed restorer line resistant to rust released by USDA and the North Dakota Agricultural Experiment Station in 2001. The rust *R* gene in HA-R8 was named *R15* and mapped to LG8. HA-R20 was developed by the pedigree breeding method and DNA marker-assisted selection for pyramiding of the rust *R*-genes *R15* from HA-R8 and *R12* from HA-DM2 and the DM *R* gene *PlArg* from HA-DM2. F1 hybrids were created by crossing HA-DM2 to HA-R8 in 2019. Homozygous pyramids with triple-gene combination, *R12*/*R15*/*PlArg* were selected using DNA markers from 188 F2 individuals and advanced to the F3 generation. The F3-derived HA-R20 were further evaluated for their reaction to rust and downy mildew infection and homozygosity for the both the rust *R* genes, *R15* and *R12*, and DM *R* gene *PlArg* verified by DNA markers. HA-R20 is resistant to all known races of

North American sunflower rust and all known races of the pathogen causing DM. Plant height of HA-R20 was 154 cm and flowered 64 days after planting in the field nursery at Glyndon, MN during the summer of 2021.

HA-R21 is a F3-derived F4 maintainer selection from the cross of HA-DM3 and HA-R8. HADM3 (PI 687023) is a confection maintainer line resistant to rust and DM released by USDA Sunflower and Biology Research Unit and the North Dakota Agricultural Experiment Station in 2017. HA-DM3 carries the rust *R* gene *R13a* and DM *R* gene *Pl17* mapped to sunflower LGs 13 and 4, respectively. HA-R8 (PI 607511) is described above. HA-R21 was developed by the pedigree breeding method and DNA marker-assisted selection for pyramiding of the rust *R*-genes *R15* from HA-R8 and *R13a* from HA-DM3 and the DM *R* gene *Pl17* from HA-DM3. F1 hybrids were created by crossing HA-DM3 to HA-R8 in 2019. Homozygous pyramid with triple-gene combination, *R13a*/*R15*/*Pl17* were selected using DNA markers from 188 F2 individuals and advanced to the F3 generation. The F3-derived HA-R21 were further evaluated for their reaction to rust and downy mildew infection and is homozygous for the both the rust *R* genes, *R15* and *R13a*, and DM *R* gene *Pl17* verified by DNA markers. HA-R21 is resistant to all known races of North American sunflower rust and all known races of the pathogen causing DM. Plant height of HA-R21 was 151 cm and flowered 68 days after planting in the field nursery at Glyndon, MN during the summer of 2021.

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