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Agricultural Research Service

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

AND

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

### RELEASE OF FOUR OIL SUNFLOWER MAINTAINER AND RESTORER LINES

The United States Department of Agriculture, Agricultural Research Service (USDA-ARS) announces the release of four oil sunflower maintainer and restorer lines.

Rust caused by the fungus *Puccinia helianthi* and downy mildew (DM) caused by the obligate pathogen *Plasmopara halstedii* are two of the most important yield-limiting sunflower diseases globally. There has been a long history of using resistant varieties or hybrids to control rust and DM in sunflower. However, resistance is generally not durable due to the emergence of new pathotypes that overcome current resistance sources. Stacking more than one resistance gene (*R* gene) in a hybrid is expected to considerably extend the durability of resistance due to the low probability of the pathogen being able to overcome multiple resistance genes at the same time. HA-R14, HA-R15, HA-R16, and HA-R17 were developed to pyramid different rust resistance genes, with the first three also combining DM resistance genes, providing multiple and durable resistance to both rust and DM.

HA-R14 is a F<sub>3</sub>-derived F<sub>4</sub> maintainer selection from the cross of HA-R3 and RHA 464. HA-R3 (PI 650754) is an oilseed maintainer line resistant to rust released by USDA and the North Dakota Agricultural Experiment Station in 1985. The rust resistance gene (*R* gene) in HA-R3 was named *R*<sub>4</sub> and mapped to linkage group (LG) 13 of the sunflower genome. RHA 464 (PI 665015) is an oilseed restorer line released by USDA-ARS and the North Dakota Agricultural Experiment Station in 2010 resistant to all North America rust and downy mildew (DM) races identified so far. The DM and rust resistance genes in RHA 464 were named *Pl*<sub>Arg</sub> and *R*<sub>12</sub> and mapped to LGs 1 and 11 of the sunflower genomes, respectively. HA-R14 was developed by the pedigree breeding method and DNA marker-assisted selection for pyramiding of the rust *R*-genes *R*<sub>4</sub> from HA-R3 and *R*<sub>12</sub> from RHA 464 and the DM *R* gene *Pl*<sub>Arg</sub> from RHA 464. The F<sub>3</sub>-derived HA-R14 is homozygous for the both the rust *R* genes, *R*<sub>4</sub> and *R*<sub>12</sub>, and DM *R* gene *Pl*<sub>Arg</sub> verified by DNA markers, and is resistant to all known races of North American sunflower rust and all known races of the pathogen causing DM.

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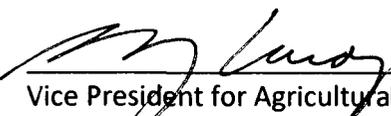
HA-R15 is a F<sub>3</sub>-derived F<sub>4</sub> maintainer selection from the cross of HA-R2 and RHA 464. HA-R2 (PI 650753) is an oilseed maintainer line resistant to rust released by USDA and the North Dakota Agricultural Experiment Station in 1985. The rust resistance gene in HA-R2 was named *R<sub>5</sub>* and mapped to LG2 of the sunflower genome. RHA 464 is described above. HA-R15 was developed by the pedigree breeding method and DNA marker-assisted selection for pyramiding of the rust *R*-genes *R<sub>5</sub>* from HA-R2 and *R<sub>12</sub>* from RHA 464 and the DM *R* gene *PI<sub>Arg</sub>* from RHA 464. The F<sub>3</sub>-derived HA-R15 is homozygous for the both the rust *R* genes, *R<sub>4</sub>* and *R<sub>12</sub>*, and DM *R* gene *PI<sub>Arg</sub>* verified by DNA markers, and is resistant to all known races of North American sunflower rust and all known races of the pathogen causing DM.

HA-R16 is a F<sub>3</sub>-derived F<sub>4</sub> restorer selection from the cross of RHA 397 and RHA 464. RHA 397 (PI 597374) is an oilseed restorer line resistant to rust released by USDA and the North Dakota Agricultural Experiment Station in 1997. The rust resistance gene in RHA 397 was named *R<sub>13b</sub>* and mapped to LG13 of the sunflower genome. RHA 464 is described above. HA-R16 was developed by the pedigree breeding method and DNA marker-assisted selection for pyramiding of the rust *R* genes *R<sub>13b</sub>* from RHA 397 and *R<sub>12</sub>* from RHA 464 and the DM *R* gene *PI<sub>Arg</sub>* from RHA 464. The F<sub>3</sub>-derived HA-R16 is homozygous for the both the rust *R* genes, *R<sub>13b</sub>* and *R<sub>12</sub>*, and DM *R* gene *PI<sub>Arg</sub>* verified by DNA markers, and is resistant to all known races of North American sunflower rust and all known races of the pathogen causing DM.

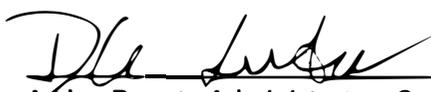
HA-R17 is a F<sub>3</sub>-derived F<sub>4</sub> restorer selection from the cross of RHA 397 and HA-R8. HA-R8 (PI 607511) is an oilseed restorer line resistant to rust released by USDA and the North Dakota Agricultural Experiment Station in 2001. The rust resistance gene in HA-R8 was named *R<sub>15</sub>* and mapped to LG8 of the sunflower genome. RHA 397 is described above. HA-R17 was developed by the pedigree breeding method and DNA marker-assisted selection for pyramiding of the rust *R*-genes *R<sub>13b</sub>* from RHA 397 and *R<sub>15</sub>* from HA-R8. The F<sub>3</sub>-derived HA-R17 is homozygous for the both the rust *R* genes, *R<sub>13b</sub>* and *R<sub>15</sub>*, verified by DNA markers, and is resistant to all known races of North American sunflower rust.

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**Signatures:**

  
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Vice President for Agricultural Affairs  
North Dakota State University

1/2/20  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Acting Deputy Administrator, Crop Production and Protection  
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1/20/20  
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