Identifying Aphid Resistance Genes in a Maize NAM Population

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Maize genetic mapping population
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B73 = sequenced maize line

+ 

B97  CML322  Il14H  M37W  Oh43
CML103  CML333  Ki11  Mo18W  Oh7B
CML228  CML52  Ki3  MS71  P39
CML247  CML69  Ky21  NC350  Tx303
CML277  Hp301  M162W  NC358  Tzi8

25 genetically diverse maize inbred lines

25 populations of 200 recombinant inbred lines, brought to the F6 generation

5000 RILs total = Nested Association Mapping (NAM) population
Aphid reproduction varies 100-fold on maize inbred lines

Number of Nymphs
Experiment 2

Rhopalosiphum maidis

Number of Nymphs
Experiment 1

$R^2 = 0.7$

Lisa Meihls and Harleen Kaur
Aphid resistance is recessive in B73 x CML322

Number of aphid progeny ± standard error

- B73 (resistant parent)
- F1 progeny
- CML322 (sensitive parent)

Maize line

Lisa Meihls and Harleen Kaur
Aphid resistance in B73 x CML322 maps to Chr. 1

An excellent gene candidate has been identified and a likely mode of action has been proposed.

Lisa Meihls and Harleen Kaur
B73 and CML322 differ in benzoxazinoid content

Lisa Meihls and Harleen Kaur
DIMBOA-Glucoside gets converted to HDMBOA-Glucoside

DIMBOA-Glucoside

MeO
\text{O} \text{Glc}
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{OH}
\end{array}
\xrightarrow{\beta-\text{glucosidase}}
MeO
\text{O} \text{Glc}
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{OH}
\end{array}

24 hours

\xrightarrow{24 \text{ hours}}
MeO
\begin{array}{c}
\text{N} \\
\text{O}
\end{array}

\text{MBOA}

Herbivory

HDMBOA-Glucoside

MeO
\text{O} \text{Glc}
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{OMe}
\end{array}
\xrightarrow{\beta-\text{glucosidase}}
MeO
\text{O} \text{Glc}
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{OMe}
\end{array}

HDMBOA

\text{No callose formation}

\text{Really fast}

Oikawa et al., Phytochemistry 22:2995-3001, 2004
Grambow et al., Zeitschrift für Naturforshung 41:684, 1986
Is there a tradeoff in maize defense?

HDMBOA

Better against caterpillars

or

DIMBOA

Better against aphids
Aphid resistance in B73 x NC350 maps to Chr. 2 and 5

Aphid resistance QTL

Rhopalosiphum maidis

Lisa Meihls and Harleen Kaur