

Supplementary: Nitrogen Use Efficiency and the Genetic Variation of Maize Expired Plant Variety Protection Germplasm

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Table S1. Maize line name, year of release, heterotic group, and proprietary company name of Ex-Plant Variety Protection (PVP) inbreds used as parents in this study.

Line †	Year Released	Heterotic Group‡	Company
PH207	2002	Iodent	Pioneer Hi-Bred International, Inc.
LH82	2003	Iodent	Holden's Foundation Seeds, Inc.
IB014	2004	Iodent	DeKalb-Pfizer Genetics
PHG29	2004	Iodent	Pioneer Hi-Bred International, Inc.
PHG72	2005	Iodent	Pioneer Hi-Bred International, Inc.
PHP02	2007	Iodent	Pioneer Hi-Bred International, Inc.
PHH93	2007	Iodent	Pioneer Hi-Bred International, Inc.
IBB15	2008	Iodent	DeKalb-Pfizer Genetics
IBC2	2008	Iodent	DeKalb-Pfizer Genetics
J8606	2008	Iodent	Novartis Seeds, Inc.
PHN82	2008	Iodent	Pioneer Hi-Bred International, Inc.
PHP76	2009	Iodent	Pioneer Hi-Bred International, Inc.
83IBI3	2010	Iodent	DeKalb-Pfizer Genetics
LH164	2010	Iodent	Holden's Foundation Seeds, Inc.
904	2010	Iodent	Novartis Seeds, Inc.
911	2010	Iodent	Novartis Seeds, Inc.
912	2010	Iodent	Novartis Seeds, Inc.
PHM81	2010	Iodent	Pioneer Hi-Bred International, Inc.
PHKE6	2011	Iodent	Pioneer Hi-Bred International, Inc.
Mo17	1973	Lancaster	Public
LH51	2001	Lancaster	Holden's Foundation Seeds, Inc.
MDF-13D	2002	Lancaster	DeKalb-Pfizer Genetics
LH123	2003	Lancaster	Holden's Foundation Seeds, Inc.
MBNA	2004	Lancaster	DeKalb-Pfizer Genetics
LH54	2005	Lancaster	Holden's Foundation Seeds, Inc.
LH52	2005	Lancaster	Holden's Foundation Seeds, Inc.
LH60	2005	Lancaster	Holden's Foundation Seeds, Inc.
PHG47	2005	Lancaster	Pioneer Hi-Bred International, Inc.
PHG84	2005	Lancaster	Pioneer Hi-Bred International, Inc.
PHJ40	2005	Lancaster	Pioneer Hi-Bred International, Inc.
PHZ51	2005	Lancaster	Pioneer Hi-Bred International, Inc.
78371A	2006	Lancaster	DeKalb-Pfizer Genetics
MBPM	2006	Lancaster	DeKalb-Pfizer Genetics

LH59	2006	Lancaster	Holden's Foundation Seeds, Inc.
LH65	2006	Lancaster	Holden's Foundation Seeds, Inc.
740	2006	Lancaster	Novartis Seeds, Inc.
S8324	2006	Lancaster	Novartis Seeds, Inc.
2MA22	2007	Lancaster	DeKalb-Pfizer Genetics
78551S	2008	Lancaster	DeKalb-Pfizer Genetics
E8501	2008	Lancaster	Novartis Seeds, Inc.
PHJ31	2008	Lancaster	Pioneer Hi-Bred International, Inc.
PHN73	2008	Lancaster	Pioneer Hi-Bred International, Inc.
LH128	2009	Lancaster	Holden's Foundation Seeds, Inc.
LH181	2009	Lancaster	Holden's Foundation Seeds, Inc.
PHK56	2009	Lancaster	Pioneer Hi-Bred International, Inc.
MBSJ	2010	Lancaster	DeKalb-Pfizer Genetics
LH216	2010	Lancaster	Holden's Foundation Seeds, Inc.
LH213	2010	Lancaster	Holden's Foundation Seeds, Inc.
BCC03	2010	Lancaster	Novartis Seeds, Inc.
PHJ89	2010	Lancaster	Pioneer Hi-Bred International, Inc.
Lp215D	2010	Lancaster	Wilson Hybrids, Inc.
ICI581	2011	Lancaster	Advanta Technology Limited
LH214	2011	Lancaster	Holden's Foundation Seeds, Inc.
B73	1973	Stiff-stalk synthetic	Public
LH1	1994	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
FAPW	2002	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
LH145	2002	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
PHG39	2002	Stiff-stalk synthetic	Pioneer Hi-Bred International, Inc.
PHG35	2002	Stiff-stalk synthetic	Pioneer Hi-Bred International, Inc.
4676A	2004	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
78002A	2004	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
764	2005	Stiff-stalk synthetic	Novartis Seeds, Inc.
778	2005	Stiff-stalk synthetic	Novartis Seeds, Inc.
794	2005	Stiff-stalk synthetic	Novartis Seeds, Inc.
FBHJ	2006	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
PB80	2006	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
LH149	2006	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
807	2006	Stiff-stalk synthetic	Novartis Seeds, Inc.
790	2006	Stiff-stalk synthetic	Novartis Seeds, Inc.
793	2006	Stiff-stalk synthetic	Novartis Seeds, Inc.
H8431	2006	Stiff-stalk synthetic	Novartis Seeds, Inc.
S8326	2006	Stiff-stalk synthetic	Novartis Seeds, Inc.
PHT55	2006	Stiff-stalk synthetic	Pioneer Hi-Bred International, Inc.
W8304	2007	Stiff-stalk synthetic	Novartis Seeds, Inc.
2FACC	2008	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
W8555	2008	Stiff-stalk synthetic	Novartis Seeds, Inc.

LH220Ht	2009	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
LH208	2009	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
PHV07	2009	Stiff-stalk synthetic	Pioneer Hi-Bred International, Inc.
ICI441	2010	Stiff-stalk synthetic	Advanta Technology Limited
FBLA	2010	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
NL001	2010	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
F118	2010	Stiff-stalk synthetic	DeKalb-Pfizer Genetics
LH191	2010	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
LH197	2010	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.
PHGG7	2010	Stiff-stalk synthetic	Pioneer Hi-Bred International, Inc.
ICI193	2011	Stiff-stalk synthetic	Advanta Technology Limited
ICI740	2011	Stiff-stalk synthetic	Advanta Technology Limited
LH209	2011	Stiff-stalk synthetic	Holden's Foundation Seeds, Inc.

†Public lines were developed by Iowa State University (B73) and University of Missouri (Mo17).

‡Heterotic groups were defined using discriminant analysis of principal components [33] and 26,768 single nucleotide polymorphism markers.

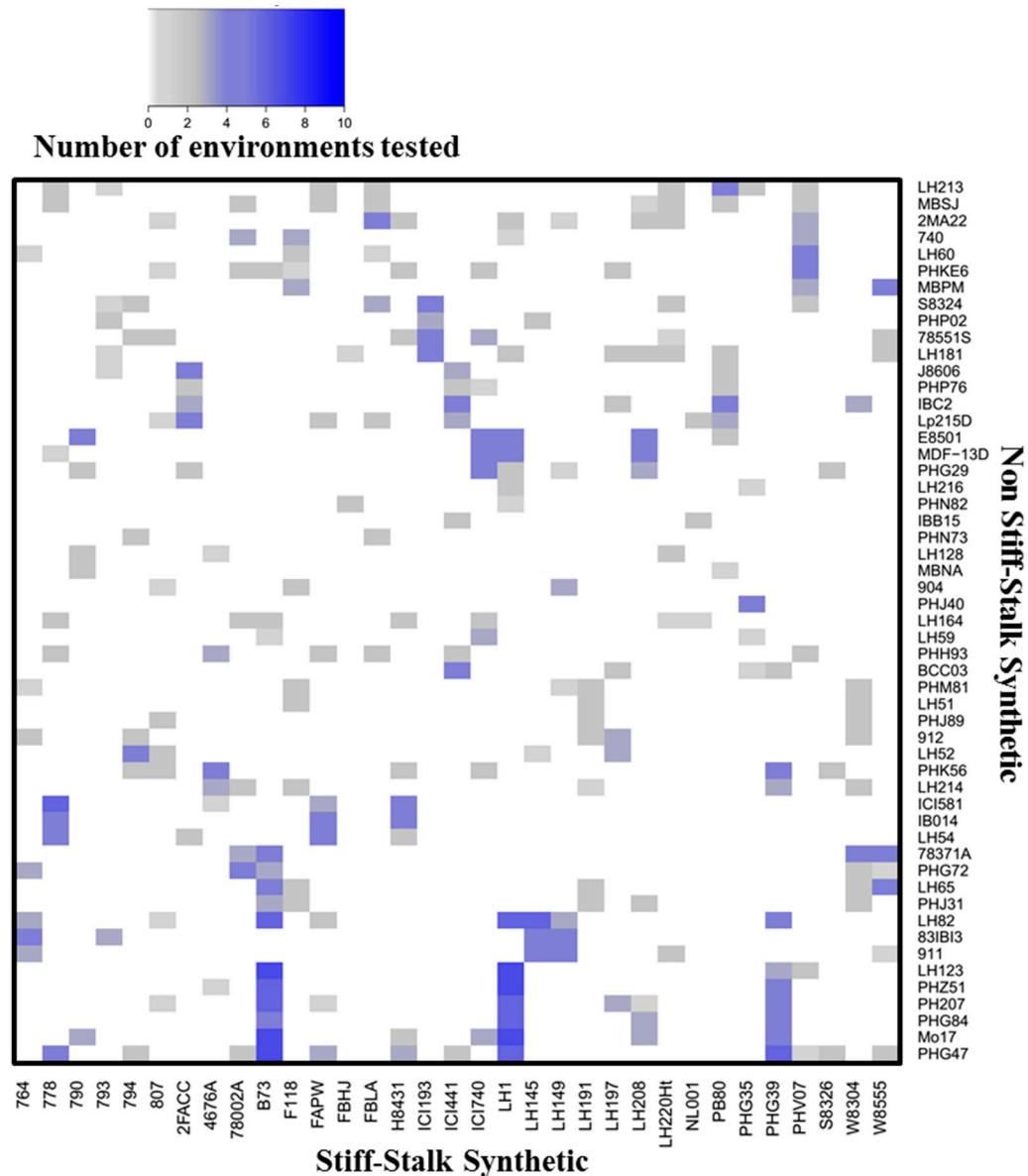


Figure S1. Heatmap showing maize hybrid combinations between 36 stiff-stalk synthetic and 53 non-stiff-stalk synthetic lines developed with the corresponding number of environments tested over three locations in Illinois from 2011 to 2015.