Supplementary Material

Nitrogen fertilization increases wind damage in an aggrading forest

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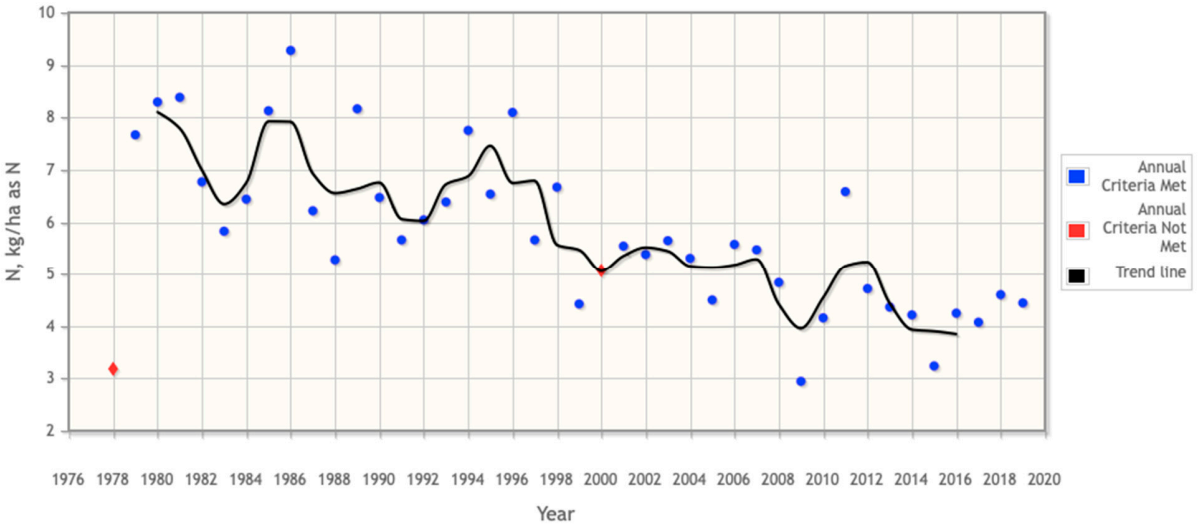

Figure S1. Total inorganic nitrogen wet deposition from nitrate and ammonium at National Atmospheric Deposition Program (NADP) station WV18 in Parsons, WV, USA (adjacent to Fernow). Points represent annual weighted mean nitrogen concentrations – blue points indicate when the NADP quality control criteria were met and red points indicate when criteria were not met. The trend line is a three year moving average with a resolution of one year. Data and visualization generated from the NADP database (http://nadp.slh.wisc.edu).

Table S1. Tree species composition by percentage of stems and percentage of basal area (BA) across three treatments in the LTSP experiment. Data is from pre-disturbance measurements in 2009 from Fowler et al. 2014.

	Treatment					
	Reference		+N		+N+L	
Species	% BA	% Stems	% BA	% Stems	% BA	% Stems
Acer pensylvanicum	1.9	5.1	0.5	2.0	1.3	4.4
Acer rubrum	1.4	2.4	3.6	7.6	3.0	5.2
Acer saccharum	0.1	0.2	0.0	0.0	0.5	2.5
Aralia spinosa	1.0	1.4	0.8	2.3	1.4	3.3
Betula alleghaniensis	0.3	0.1	0.0	0.0	0.0	0.0
Betula lenta	20.4	25.3	6.2	13.6	2.9	8.1
Caprinus Caroliniana	0.2	0.4	0.2	0.7	0.3	0.7
Fraxinus americana	0.3	1.0	0.0	0.0	0.0	0.0
Ilex ambigua ambigua	0.0	0.0	0.0	0.0	0.0	0.1
Liriodendron tulipifera	15.9	20.0	3.4	10.3	11.6	16.0
Magnolia acuminata	2.3	1.4	0.2	0.5	1.1	1.0
Magnolia fraseri	0.2	0.4	1.9	3.2	0.0	0.1
Ostrya virginiana	0.1	0.2	0.0	0.1	0.4	1.5
Oxydendrum arboreum	0.0	0.0	0.1	0.2	0.0	0.0
Prunus pensylvanica	47.5	29.1	75.0	46.2	68.7	41.4
Prunus serotina	4.9	8.2	6.3	9.9	4.6	9.7
Quercus prinus	0.1	0.2	0.0	0.0	0.0	0.2
Quercus rubra	1.4	2.5	0.6	1.8	0.7	2.2
Robinia psuedoacacia	2.0	1.8	0.8	0.7	3.0	2.5
Sassafras albidum	0.1	0.2	0.2	0.8	0.0	0.1
Tilia americana	0.0	0.0	0.0	0.1	0.4	0.9

Table S2. Species-specific hypotheses for storm damage based on published traits and responses to nitrogen and lime in fertilization and gradient studies.

Species	Common name	Traits that could affect storm damage	Hypothesized damage outcome (relative to reference)
Betula lenta	Sweet birch	Congener of Betula allegheniensis, which grows more vigorously on N-fertilized sites (*)	More damage in +N and +N+L
Liriodendron tulipifera	Tulip poplar	Diminished growth on N-fertilized site (52)	Less damage in +N and +N+L
		Decreased wood density on N-fertilized site (53)	Less damage in +N and +N+L
Prunus pensylvanica	Black cherry	Shallow rooting depth and tall stature (48)	Greater relative to other spp., and greater in +N
		Diminished growth on sites with more base cations (49)	Greater in +N+L
		Diminished growth on lime-fertilized site (50)	Greater in +N+L
Prunus serotina	Pin cherry	Noncommercial species with relatively little information, but congener of *P. serotina*	Greater relative to other spp., and greater in +N
			Greater in +N+L
			Greater in +N+L

Numbers in parentheses indicate reference number in manuscript, and * indicates the following reference:

Burns, Russell M., and Barbara H. Honkala, tech. coords. 1990. Silvics of North America: 2. Hardwoods; Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

Table S3. Results for 51 bootstrap hypothesis tests across species group, damage type, and damage severity as either percentage of stems or basal area of trees damaged from the 2009 windstorm. Comparison denotes the direction of the one-tailed test between treatments and *p* is the bootstrap *p*-value. $p_{B\text{-}H}$ is the Benjamini-Hochberg adjusted *p*-value – an estimate of the false positive rate of all positive hypothesis tests from rank 1, up to and including that tests' rank.

Species	Damage type	Damage severity	Metric	Comparison	*p*	Rank	$p_{B\text{-}H}$
All	All	Prostrate	Stems	+N > Ref	0.000	1	0.000
All	All	Extensive	Stems	+N+L < Ref	0.000	2	0.000
P. serotina	All	All	Stems	+N+L > Ref	0.000	3	0.004
P. serotina	All	All	Basal area	+N+L > Ref	0.000	4	0.003
All	All	Prostrate	Stems	+N > +N+L	0.000	5	0.003
All	All	Moderate	Stems	+N < +N+L	0.004	6	0.030
All	All	Moderate	Stems	+N+L > Ref	0.007	7	0.047
L. tulipifera	All	All	Stems	+N+L < Ref	0.008	8	0.054
All	Snap	All	Stems	+N > Ref	0.010	9	0.057
All	All	All	Stems	+N+L > Ref	0.012	10	0.059
L. tulipifera	All	All	Basal area	+N > +N+L	0.016	11	0.072
All	Snap	All	Stems	+N+L > Ref	0.021	12	0.085
All	All	All	Basal area	+N+L > Ref	0.022	13	0.085
L. tulipifera	All	All	Stems	+N > +N+L	0.025	14	0.092
P. serotina	All	All	Basal area	+N > Ref	0.031	15	0.104
All	All	Prostrate	Stems	+N+L > Ref	0.038	16	0.117
All	All	All	Basal area	+N > Ref	0.045	17	0.117
P. Pensylvanica	All	All	Stems	+N+L > Ref	0.045	18	0.117
All	All	All	Stems	+N > Ref	0.047	19	0.117
P. serotina	All	All	Stems	+N < +N+L	0.047	20	0.117
All	All	Extensive	Stems	+N < Ref	0.048	21	0.117
All	Bent	All	Stems	+N > +N+L	0.058	22	0.135
All	Tipup	All	Stems	+N+L > Ref	0.063	23	0.139
P. serotina	All	All	Stems	+N > Ref	0.067	24	0.142
B. lenta	All	All	Stems	+N < Ref	0.072	25	0.147
All	Tipup	All	Stems	+N > Ref	0.080	26	0.156
L. tulipifera	All	All	Basal area	+N+L < Ref	0.102	27	0.193
L. tulipifera	All	All	Basal area	+N > Ref	0.112	28	0.196
All	Snap	All	Stems	+N > +N+L	0.114	29	0.196
All	Bent	All	Stems	+N > Ref	0.116	30	0.196
P. serotina	All	All	Basal area	+N < +N+L	0.126	31	0.207
B. lenta	All	All	Stems	+N < +N+L	0.158	32	0.252
P. Pensylvanica	All	All	Stems	+N < +N+L	0.170	33	0.262
B. lenta	All	All	Basal area	+N < Ref	0.205	34	0.308
All	All	Extensive	Stems	+N > +N+L	0.236	35	0.344
P. Pensylvanica	All	All	Basal area	+N < +N+L	0.253	36	0.359
All	All	Significant	Stems	+N > Ref	0.290	37	0.393
P. Pensylvanica	All	All	Stems	+N > Ref	0.296	38	0.393
P. Pensylvanica	All	All	Basal area	+N+L > Ref	0.301	39	0.393
B. lenta	All	All	Basal area	+N+L < Ref	0.345	40	0.440
B. lenta	All	All	Basal area	+N < +N+L	0.355	41	0.437
All	Bent	All	Stems	+N+L < Ref	0.360	42	0.437
B. lenta	All	All	Stems	+N+L < Ref	0.379	43	0.449
All	Tipup	All	Stems	+N < +N+L	0.413	44	0.479
P. Pensylvanica	All	All	Basal area	+N < Ref	0.440	45	0.499
L. tulipifera	All	All	Stems	+N > Ref	0.458	46	0.507
All	All	Significant	Stems	+N+L > Ref	0.467	47	0.507
All	All	Moderate	Stems	+N < Ref	0.469	48	0.495
All	All	All	Basal area	+N < +N+L	0.476	49	0.495
All	All	All	Stems	+N < +N+L	0.487	50	0.497
All	All	Significant	Stems	+N < +N+L	0.691	51	0.691