

Supplemental Information: Details of pedigree of research materials, climate, chlorophyll and nitrogen concentrations

Sup Table 1: Details of inbred plant materials and F1 seeds harvested for hybrid trial A1

-----Plantation on Sep 15, 2011-----						--Harvested on March 2012--	
Female parent	Inbred Origin	Pedigree of inbred	Male parent	ORIGIN	Pedigree of inbred	Hybrid	Hybrid entries
RML-19	CIMMYT	CA34501	NML2 OR RML2	CIMMYT	CML 430	RML-19/NML-2	1
RL-137	NEPAL	UPAHAR-B-54-1-1-2-1	RL-168	NEPAL	POOL-21-29-1-1-2-1-1	RL-137/RL-168	2
RML-55	CIMMYT	CML 168	RL-29	NEPAL	na	RML-55/RL-29	3
RL-99	NEPAL	UPAHAR-B-20-2-2-2-1	RL-161	NEPAL	POOL-21-17-1-1-1-1-1	RL-99/RL-161	4
RML-6	CIMMYT	CA34514	RML-19	CIMMYT	CA34501	RML-6/RML-19	5
RL-111	NEPAL	UPAHAR-B-31-1-1-1-1	RL-189	NEPAL	POOL-21-32-1-3-3-2-1	RL-111/RL-189	6
RML-95	CIMMYT	PUTU 17	RML-96	CIMMYT	AG 27	RML-95/RML-96	7
RML-86	CIMMYT	PUTU 20	RML-96	CIMMYT	AG 27	RML-86/RML-96	8
RL-36	NEPAL	na	RL-197	NEPAL	POOL-21-32-1-4-3-3-1	RL-36/RL-197	9
RL-180	NEPAL	POOL-21-32-1-1-2-1-1	RML-5	CIMMYT	CA00314	RL-180/RML-5	10
RML-57	CIMMYT	CLQG-6602	RML-6	CIMMYT	CA34514	RML-57/RML-6	11
RL-170	NEPAL	POOL-21-29-1-1-3-1-1	RL-111	NEPAL	UPAHAR-B-31-1-1-1-1-1	RL-170/RL-111	12
RL-154	NEPAL	POOL-21-12-1-2-1-4-1	RL-111	NEPAL	UPAHAR-B-31-1-1-1-1-1	RL-154/RL-111	13
RML-4	CIMMYT	CA00326	NML2 OR RML2	CIMMYT	CML 430	RML-4/NML-2	14
NML 1 or RML1	CIMMYT	CML-433	NML2 OR RML2	CIMMYT	CML 430	Gaurav	15

na = not available

Sup Table 2: Transformation equations from SPAD to leaf chl and N contents

For Estimation of , units	Transformation equations	R ² value	Reference
For leaf nitrogen on % dry weight (1) Preanthesis	$Y = 0.708 + 0.0184 X + 0.0004X^2$	(R ² =0.77)	Dwyer et al., 1995
For leaf nitrogen on % dry weight (2) 2-week AA	$Y = 0.708 + 0.00898X + 0.0004X^2$	(R ² =0.82)	Dwyer et al., 1995
For leaf nitrogen on % dry weight (3) 5-week AA	$Y = 0.494 + 0.026 X + 0.0009 X^2$	(R ² =0.85)	Dwyer et al., 1995
For leaf Chlorophyll content estimation (µg cm ⁻²)	$Y = (99 * X)/(144 - X)$		Cerovic et al., 2012

^ψWhere X is SPAD value

AA = After anthesis

Dwyer LM, AM Anderson, BL Ma, DW Stewart, M Tollenaar, and E Gregorich. 1995. Quantifying the non-linearity in Chlorophyll meter response to corn leaf nitrogen concentration. Canadian Journal of Plant Science 75: 179-182.

Cerovic ZG, G Masdoumier, NB Ghazlen, G Latouche. 2012. A new optical leaf-clip meter for simultaneous non-destructive assessment of leaf Chlorophyll and epidermal flavonoids. Physiology Plant, 146(3): 251–260.

Dwyer LM, AM Anderson, BL Ma, DW Stewart, M Tollenaar, and E Gregorich. 1995. Quantifying the non-linearity in Chlorophyll meter response to corn leaf nitrogen concentration. Canadian Journal of Plant Science 75:- 179-182.

Sup Table 3: Characterization of growing duration of the maize hybrids. It was in subtropical winter in Nepal 2012-2013 (Base temp 10⁰C for growing ⁰days computation).

From d-m-year	To d-m-year	DAS days	Degree days	Cum ⁰ Days	Mean Temp	Eff Temp Mean	Av Mx Temp	Av Min Temp	Mx Temp Max	Mx Temp Min	Min Temp Max	Min Temp Min	RH %
4-Oct-12	8-Oct-12	1-5	79.4	79.4	25.9	15.9	32.7	19.0	33.1	32.4	20.8	18.0	93.5
9-Oct-12	18-Oct-12	6-15	144.5	223.9	24.5	14.5	31.3	17.6	31.9	30.7	23.3	14.7	93.5
19-Oct-12	28-Oct-12	16-25	106.3	330.2	20.6	10.6	29.7	11.6	30.8	28.3	14.0	9.0	95.4
29-Oct-12	7-Nov-12	26-35	91.6	421.8	19.2	9.2	29.7	8.6	30.3	29.2	10.2	7.6	94.1
8-Nov-12	17-Nov-12	36-45	75.7	497.5	17.6	7.6	27.6	7.5	28.7	26.7	9.3	6.1	95.9
18-Nov-12	27-Nov-12	46-55	68.2	565.7	16.8	6.8	26.8	6.9	28.8	24.8	8.9	5.6	94.6
28-Nov-12	7-Dec-12	56-65	57.2	622.8	15.7	5.7	25.0	6.5	25.4	24.3	7.7	5.7	95.3
8-Dec-12	17-Dec-12	66-75	51.8	674.6	15.2	5.2	23.2	7.2	24.7	22.2	9.7	5.4	97.1
18-Dec-12	27-Dec-12	76-85	29.5	704.2	13.0	3.0	20.3	5.6	21.8	18.2	8.5	2.2	94.9
28-Dec-12	6-Jan-13	86-95	21.5	725.7	12.2	2.2	22.3	2.1	24.2	18.3	3.3	-0.8	92.2
7-Jan-13	16-Jan-13	96-105	-7.6	718.1	9.2	-0.8	18.8	-0.3	22.4	10.1	1.2	-2.5	93.7
17-Jan-13	26-Jan-13	106-115	25.4	743.5	12.5	2.5	21.2	3.9	24.3	14.9	8.4	1.6	95.4
27-Jan-13	5-Feb-13	116-125	41.7	785.2	14.2	4.2	24.4	3.9	27.2	20.4	9.3	1.7	94.5
6-Feb-13	15-Feb-13	126-135	54.3	839.5	15.4	5.4	24.8	6.0	26.8	20.8	10.1	2.4	92.9
16-Feb-13	25-Feb-13	136-145	70.5	910.0	17.1	7.1	25.5	8.7	28.8	21.5	12.5	4.1	87.6
26-Feb-13	7-Mar-13	146-155	103.0	1013.0	20.3	10.3	30.8	9.8	32.2	29.9	12.6	5.1	89.8
8-Mar-13	17-Mar-13	156-165	123.4	1136.4	22.3	12.3	32.5	12.1	35.2	31.3	13.3	11.1	86.5
18-Mar-13	27-Mar-13	166-175	120.6	1257.0	22.1	12.1	31.6	12.5	33.4	30.4	14.3	10.5	83.4
28-Mar-13	6-Apr-13	176-185	143.0	1400.0	24.3	14.3	34.0	14.6	36.5	31.6	15.7	11.9	82.2

Sup Table 4A: Mean square values of leaf SPAD of the hybrids in the trial A₁. It was during the grain filling stage in ten days interval

SOV	DF	Yield	E0SP95	E0SP105	E0SP115	E0SP125	E0SP135	E0SP145	E0SP155
REPLICA	2	19.11	33.99	10.59	17.71	20.66	6.16	9.36	140.74
HYBRIDS	14	6.166*	7.622 ns	9.425 ns	12.624ns	11.92ns	15.14ns	24.633**	61.77ns
RESIDUAL	28	2.90	7.57	9.18	9.94	10.52	11.81	9.35	69.62

Sup Table 4B: Mean square values of E3 leaf SPAD

SOV	DF	100%PopSen	E3SP95	E3SP105	E3SP115	E3SP125	E3SP135	E3SP145	E3SP155
REPLI	2	9.49	25.97	6.15	9.64	16.57	24.28	36.33	20.20
HYBRIDS	14	12.022**	28.558**	33.55**	40.24**	44.89**	59.51**	70.34**	126.75**
RESIDUAL	28	3.35	9.90	11.96	13.12	12.67	13.19	16.53	21.27

Sup Table 4C: Mean square values of E0 chl contents in $\mu\text{g cm}^{-2}$

SOV	DF	E095Chl	E0105Chl	E0115Chl	E0125Chl	E0135Chl	E0145Chl	E0155Chl
REPLI	2	105.24	29.93	46.02	50.96	11.28	16.01	227.30
HYBRIDS	14	24.39ns	27.67ns	34.28ns	33.58ns	44.09ns	71.16**	106.4ns
RESIDUAL	28	22.45	25.19	26.69	29.09	31.79	24.78	104.60

Sup Table 4D: Mean square values of E3 chl contents in $\mu\text{g cm}^{-2}$.

SOV	DF	E3-95Chl	E3-105Chl	E3-115Chl	E3-125Chl	E3-135Chl	E3-145Chl	E3-155Chl
REPLI	2	60.24	15.52	22.40	31.66	48.14	70.64	20.60
HYBRIDS	14	60.86**	67.36**	79.25**	86.36**	117.53**	132.74**	193.45**
RESIDUAL	28	23.18	24.63	25.24	24.55	25.97	33.39	33.13

Sup Table 4E: Mean square values of E0 N contents

SOV	DF	1E0 N%PreA	2E095N D	2E0105N D	3E0115ND	3E0125N D	3E0135 N D	E0145N D	E0155 N D
REPLICA	2	0.13	0.09	0.03	0.24	0.26	0.06	0.09	1.13
HYBRIDS	14	0.02955ns	0.02113ns	0.02404ns	0.1712ns	0.1678ns	0.2153ns	0.3484**	0.5413ns
RESIDUAL	28	0.03	0.02	0.02	0.13	0.15	0.16	0.12	0.53

Sup Table 4F: Mean square values of E3 leaf N contents

SOV	DF	1E3 N%PreD	2E3-95N D	2E3-105N D	3E3-115N D	3E3-125N D	3E3-135N D	3E3-145 N D	3E3-155N D
REPLICA	2	0.08	0.05	0.01	0.11	0.16	0.25	0.37	0.11
HYBRIDS	14	0.08308**	0.05689**	0.06335**	0.4231**	0.4561**	0.6162**	0.6924**	1.012**
RESIDUAL	28	0.03	0.02	0.02	0.13	0.13	0.14	0.17	0.17

Sup Table 5A: DMRT of hybrids for leaf chl. Chl content is in $\mu\text{g cm}^{-2}$ among the fifteen maize hybrids

Entries	Popsen100%		^c E095Chl	E0105Chl	E0115Chl	E0125Chl	E0135Chl	E0145Chl		E0155ChlZ
8	175.33	D	63.00	59.78	59.34	63.30	63.43	61.25	AB	45.27
12	181.67	A	61.61	58.52	57.30	57.41	57.91	59.11	ABC	46.82
11	179.00	ABC	62.46	60.14	56.86	59.31	59.00	66.28	A	55.98
13	180.00	AB	58.15	54.81	50.52	52.30	47.90	48.26	D	34.61
5	178.33	ABCD	61.56	56.64	53.72	56.99	54.38	55.29	BCD	42.31
6	178.33	ABCD	57.57	58.07	53.55	54.77	51.94	51.20	CD	34.45
10	180.00	AB	63.56	62.31	56.84	57.35	57.06	59.63	ABC	53.32
1	178.33	ABCD	64.79	61.09	59.68	56.83	55.91	57.39	ABCD	44.54
7	175.67	CD	55.53	53.69	49.15	52.79	54.64	55.62	BCD	41.10
14	176.33	CD	58.80	54.29	55.13	54.32	53.42	55.32	BCD	47.38
2	176.67	BCD	60.60	55.75	52.45	52.46	52.64	51.55	BCD	39.19
9	177.00	BCD	62.34	62.60	55.85	57.10	53.19	56.24	BCD	47.72
15	176.67	BCD	57.14	54.66	52.30	51.98	51.12	52.45	BCD	42.50
4	175.33	D	64.60	58.25	58.35	59.97	57.55	54.82	BCD	46.98
3	175.00	D	59.43	54.42	50.05	52.39	51.43	48.26	D	41.31
Mean	177.58		60.74	57.67	54.74	55.95	54.77	55.51		44.23

^cLeaf chlorophyll concentration was calculated from the transformation equation $Y = (99 * X) / (144 - X)$ which has been given by Cerovic et al. (2012).

Cerovic ZG, G Masdoumier, NB Ghazlen, G Latouche. 2012. A new optical leaf-clip meter for simultaneous non-destructive assessment of leaf Chlorophyll and epidermal flavonoids. *Physiology Plant*, 146(3): 251–260.

Sup Table 5B: DMRT of hybrids for leaf chl. Chl content is in $\mu\text{g cm}^2$ among the fifteen maize hybrids

Entries	E3-95Chl		E3-105Chl		E3-115Chl		E3-125Chl		E3-135Chl		E3-145Chl		E3-155Chl	
8	50.50	A	44.69	ABCD	42.69	BCDE	44.29	CDE	44.42	CDE	43.67	BCD	30.89	DEF
12	50.71	A	53.09	A	51.62	AB	56.27	A	57.56	A	52.50	AB	47.04	AB
11	53.70	A	52.47	A	53.15	A	53.99	AB	56.55	AB	57.03	A	49.62	A
13	49.30	AB	47.65	ABC	46.36	ABCD	48.14	ABCD	47.24	BCDE	48.55	ABCD	40.92	ABCD
5	53.18	A	48.81	ABC	45.59	ABCD	47.45	ABCD	45.57	CDE	46.97	ABCD	42.89	ABC
6	48.56	AB	47.97	ABC	46.02	ABCD	49.07	ABCD	47.30	BCDE	45.53	BCD	37.34	BCDE
10	53.71	A	50.87	AB	47.44	ABCD	47.86	ABCD	47.73	BCDE	47.74	ABCD	38.68	ABCD
1	48.84	AB	43.34	ABCD	42.13	BCDE	40.78	DE	41.21	DEF	39.59	DE	33.73	CDE
7	38.63	C	36.91	D	35.64	E	35.61	E	33.54	F	29.80	E	21.66	F
14	44.39	ABC	42.43	BCD	39.34	CDE	41.17	DE	39.01	EF	37.91	DE	26.53	EF
2	50.82	A	51.32	AB	52.58	A	52.26	ABC	53.29	ABC	51.48	ABC	48.43	A
9	51.88	A	50.57	AB	48.44	ABC	46.28	BCD	49.09	ABCD	44.74	BCD	32.62	CDE
15	40.38	BC	39.71	CD	38.28	DE	41.95	DE	44.09	CDE	40.52	CD	30.91	DEF
4	50.39	A	48.28	ABC	46.45	ABCD	47.08	ABCD	43.99	CDE	40.66	CD	39.44	ABCD
3	48.65	AB	46.80	ABC	47.22	ABCD	47.31	ABCD	45.98	CDE	43.53	BCD	35.06	CDE
Mean	48.91		46.99		45.53		46.63		46.44		44.68		37.05	
LSD	8.05		8.30		8.40		8.29		8.52		9.67		9.63	

^z Leaf chlorophyll content has been estimated by the transformation equation ' $Y = (99 * X) / (144 - X)$ ' given by Cerovic et al. (2012).

Sup Table 5C: DMRT of hybrids for leaf N. N is in percent dry weight of ear (E0) leaf sectors of the maize hybrids

Entries	¹ E0NPre-A	² E095N D	² E0105N	³ E0115N	³ E0125N	³ E0135 N	³ E0145N	³ E0155 N	¹ E3 N Pre-A
8	2.98	2.46	2.36	4.49	4.77	4.76	4.63 AB	3.50	2.54 A
12	2.94	2.42	2.33	4.37	4.38	4.41	4.50 ABC	3.61	2.55 A
11	2.97	2.45	2.38	4.33	4.51	4.49	4.97 A	4.27	2.66 A
13	2.82	2.32	2.22	3.88	4.00	3.69	3.71 D	2.75	2.50 A
5	2.94	2.42	2.27	4.12	4.34	4.15	4.22 BCD	3.30	2.64 A
6	2.80	2.30	2.32	4.10	4.19	3.99	3.93 CD	2.73	2.47 AB
10	3.00	2.48	2.44	4.33	4.37	4.34	4.53 ABC	4.07	2.66 A
1	3.05	2.51	2.40	4.52	4.32	4.26	4.37 ABCD	3.47	2.49 AB
7	2.72	2.24	2.18	3.78	4.04	4.17	4.22 BCD	3.20	2.10 C
14	2.84	2.34	2.20	4.21	4.15	4.09	4.22 BCD	3.65	2.32 ABC
2	2.90	2.39	2.25	4.02	4.02	4.04	3.96 BCD	3.07	2.56 A
9	2.96	2.44	2.45	4.26	4.35	4.08	4.29 BCD	3.67	2.60 A
15	2.78	2.29	2.21	4.00	3.98	3.92	4.01 BCD	3.30	2.17 BC
4	3.04	2.51	2.32	4.44	4.56	4.39	4.19 BCD	3.63	2.54 A
3	2.87	2.36	2.21	3.84	4.01	3.94	3.72 D	3.20	2.48 AB
Mean	2.91	2.39	2.30	4.18	4.27	4.18	4.23	3.43	2.48
LSD	0.28	0.23	0.25	0.61	0.64	0.67	0.59	1.21	0.30

⁽¹⁾The same SPADs recorded on 95th day have been transformed into preanthesis nitrogen estimate (Pre-A) by equations of Dwyer et al., 1995
Dwyer LM, AM Anderson, BL Ma, DW Stewart, M Tollenaar, and E Gregorich. 1995. Quantifying the non-linearity in Chlorophyll meter response to corn leaf nitrogen concentration. Canadian Journal of Plant Science 75:- 179-182.

Sup Table 5D: DMRT of hybrids for leaf N. It is mean values of percent dry weight of E3 leaf nitrogen of the maize hybrids

Entries	² E3-95N D		² E3-105N D		³ E3-115N D		³ E3-125N D		³ E3-135N D		³ E3-145 N D		³ E3-155N D	
8	2.09	AB	1.91	ABCD	3.31	BCDE	3.42	CDE	3.44	CD	3.38	BCD	2.47	EFG
12	2.09	AB	2.17	A	3.96	AB	4.30	A	4.38	A	4.02	AB	3.62	ABC
11	2.18	A	2.15	A	4.07	A	4.13	AB	4.31	AB	4.34	A	3.82	A
13	2.05	AB	2.00	ABC	3.58	ABCD	3.71	ABCD	3.64	BCD	3.74	ABCD	3.18	ABCDE
5	2.17	AB	2.04	AB	3.53	ABCD	3.66	ABCD	3.52	CD	3.62	ABCD	3.32	ABCD
6	2.03	ABC	2.01	ABC	3.56	ABCD	3.78	ABCD	3.65	BCD	3.52	BCD	2.92	CDEF
10	2.18	A	2.10	AB	3.65	ABCD	3.68	ABCD	3.67	BCD	3.66	ABCD	3.02	BCDE
1	2.04	ABC	1.87	BCD	3.27	BCDE	3.17	DE	3.20	DE	3.08	DE	2.66	DEF
7	1.72	D	1.67	D	2.79	E	2.79	E	2.64	E	2.38	E	1.78	G
14	1.90	BCD	1.84	BCD	3.07	CDE	3.21	DE	3.05	DE	2.97	DE	2.15	FG
2	2.10	AB	2.11	AB	4.03	A	4.01	ABC	4.08	ABC	3.95	ABC	3.73	AB
9	2.13	AB	2.09	AB	3.73	ABC	3.58	BCD	3.78	ABCD	3.46	BCD	2.58	DEF
15	1.78	CD	1.76	CD	2.99	DE	3.26	DE	3.41	CD	3.15	CD	2.46	EFG
4	2.09	AB	2.02	ABC	3.59	ABCD	3.64	ABCD	3.41	CD	3.16	CD	3.07	ABCDE
3	2.03	ABC	1.97	ABC	3.64	ABCD	3.65	ABCD	3.55	CD	3.37	BCD	2.75	DEF
Mean	2.04		1.98		3.52		3.60		3.58		3.45		2.90	
LSD	0.24		0.25		0.61		0.60		0.62		0.70		0.69	

⁽¹⁾The same SPADs recorded on 95th day have been transformed into preanthesis nitrogen estimate (Pre-A) by equations of Dwyer et al., 1995
Dwyer LM, AM Anderson, BL Ma, DW Stewart, M Tollenaar, and E Gregorich. 1995. Quantifying the non-linearity in Chlorophyll meter response to corn leaf nitrogen concentration. Canadian Journal of Plant Science 75:- 179-182.