

# Yield Comparisons between Cotton Variety Xin Nong Mian 1 and Its Transgenic *ScALDH21* Lines under Different Water Deficiencies in a Desert-Oasis Ecotone

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## Supporting information

**Supplemental table 1. Date of irrigation and water volume (mm) for each irrigation strategies used in this study.**

Year	Irrigation protocols	Date-Volume (mm)						Total
2016	FFI	18.05-100.0	02.06-166.6				17.07-166.6	433.3
	FDI	18.05-75	02.06-125.0				17.07-125.0	325.0
	SFI		02.06-33.3	18.06-33.3	02.07-33.3	13.07-50.0	19.07-33.3	266.6
	SDI		02.06-25.0	18.06-25.0	02.07-25.0	13.07-37.5	19.07-25.0	200
	EFI		02.06-66.6	18.06-66.6	02.07-66.6		22.07-100.0	500
	EDI		02.06-50.0	18.06-50.0	02.07-50.0		22.07-75.0	375
2017	FFI	13.06-48.9	01.07-100.1	29.07-66.7	13.08-49.3	29.08-50.1	14.09-50.0	365.1
	FDI	13.06-37.5	01.07-75.0	29.07-63.4	13.08-37.5	29.08-37.0	14.09-36.9	287.3
	SFI	10.06-77.2	10.07-50.8	15.08-39.0	10.09-66.7			233.7
	SDI	10.06-55.8	10.07-38.4	15.08-29.2	10.09-50.0			173.3
	EFI	05.06-133.7	29.06-100.6	14.07-100.4	28.07-101.7	27.08-100.0	14.09-100.0	536.5
	EDI	05.06-103.3	29.06-75.0	14.07-75.0	28.07-76.7	27.08-75.0	14.09-75.0	405.1
2018	FFI	31.05-58.7	01.07-44.6	14.07-62.1	25.07-62.0	11.08-58.3	29.08-64.3	350.0
	FDI	31.05-43.3	01.07-34.2	14.07-48.1	25.07-45.3	11.08-43.7	29.08-48.3	263.0
	SFI	31.05-61.2	27.06-50.0	12.07-44.0	10.08-57.0	03.09-45.0		256.9
	SDI	31.05-45.0	27.06-37.5	12.07-34.4	10.08-42.5	03.09-33.3		192.7
	EFI	05.06-100.8	29.06-100.0	14.07-101.0	28.07-101.0	27.08-101.7	29.08-100.0	604.2
	EDI	05.06-76.2	29.06-75.0	14.07-89.0	28.07-74.1	27.08-75.0	29.08-66.1	455.4

Full forecast irrigation (FFI); 75% of full forecast irrigation (FDI); full soil moisture irrigation (SFI); 75% of full soil moisture irrigation (SDI); full flood irrigation (EFI); 75% of full flood irrigation (EDI).

**Supplemental table 2. The effects of irrigation level, plant material, irrigation method, and their interaction on the characteristics of cotton phenotype in 2017 and in 2018.**

Phenotype	2017					2018				
	Source of variation	Df	F	S	SS%	Source of variation	Df	F	S	SS%
<b>Plant height</b>	A	1	8.73	**	2.66	A	1	12.29	***	3.77
	B	2	20.00	***	12.18	B	2	11.23	***	6.89
	C	2	4.93	**	3.00	C	2	52.66	***	32.31
	A:B	2	2.91		1.77	A:B	2	4.03		2.48
	A:C	2	4.11	*	2.50	A:C	2	11.66	*	7.15
	B:C	4	13.45	***	16.38	B:C	4	1.33	***	1.63
	A:B:C	4	1.00		1.22	A:B:C	4	1.3		1.59
<b>Leaf area</b>	A	1	0.68		0.68	A	1	2.37		1.60
	B	2	8.44	***	16.87	B	2	6.08	**	8.21
	C	2	7.56	**	15.11	C	2	19.64	***	26.53
	A:B	2	0.72		1.44	A:B	2	2.46		3.32
	A:C	2	4.40	*	8.78	A:C	2	3.57	*	4.82
	B:C	4	2.34		9.36	B:C	4	1.18		3.19
	A:B:C	4	2.95	*	11.79	A:B:C	4	1.37		3.70
<b>Net photosynthetic rate</b>	A	1	0.65		0.35	A	1	1.05		0.38
	B	2	8.67	***	9.63	B	2	10.10	***	8.05
	C	2	2.97		3.30	C	2	3.75	*	2.75
	A:B	2	2.21		2.45	A:B	2	10.85	***	7.96
	A:C	2	3.42	*	3.80	A:C	2	3.20	*	2.34
	B:C	4	4.21	**	9.34	B:C	4	2.25		3.29
	A:B:C	4	0.53		1.18	A:B:C	4	1.75		2.56
<b>Chlorophyll content</b>	A	1	29.06	***	7.49	A	1	0.85		0.65
	B	2	49.69	***	25.60	B	2	4.24	*	6.49
	C	2	14.56	***	7.50	C	2	15.98	***	24.46
	A:B	2	0.90		0.46	A:B	2	0.37		0.57
	A:C	2	5.02	**	2.58	A:C	2	1.25		1.91
	B:C	4	4.03	**	4.15	B:C	4	0.66		2
	A:B:C	4	1.17	***	1.21	A:B:C	4	2.88	*	8.81
<b>Cotton yield</b>	A	1	385.59	***	14.93	A	1	0.99		0.69
	B	2	438.53	***	33.95	B	2	5.49	**	7.63
	C	2	382.84	***	29.64	C	2	18.10	***	25.15
	A:B	2	15.25	***	1.18	A:B	2	1.59		2.21
	A:C	2	57.31	***	4.44	A:C	2	15.32	***	21.29
	B:C	4	58.32	***	9.03	B:C	4	0.66		1.82
	A:B:C	4	35.09	***	5.42	A:B:C	4	1.33		3.69
<b>Seed yield</b>	A	1	131.16	***	14.04	A	1	15.78	***	14.74
	B	2	163.92	***	35.09	B	2	8.47	***	15.84
	C	2	133.81	***	28.64	C	2	4.65	*	8.70
	A:B	2	4.97	*	1.06	A:B	2	0.12		0.22
	A:C	2	21.56	***	4.61	A:C	2	2.36		4.41
	B:C	4	22.02	***	9.43	B:C	4	1.16		4.32
	A:B:C	4	12.16	***	5.20	A:B:C	4	0.35		1.30

<b>Fiber yield</b>	A	1	158.71	***	13.64	A	1	1.87		1.96
	B	2	196.74	***	33.82	B	2	7.33	**	15.30
	C	2	190.62	***	32.77	C	2	5.69	**	11.89
	A:B	2	4.31	*	0.74	A:B	2	1.02		2.12
	A:C	2	20.31	***	3.49	A:C	2	3.18	*	6.64
	B:C	4	24.90	***	8.56	B:C	4	0.43		1.81
	A:B:C	4	15.76	***	5.42	A:B:C	4	0.93		3.86
<b>Fiber length</b>	A	1	0.12		0.06	A	1	0.50		0.73
	B	2	68.38	***	79.34	B	2	10.04	***	29.56
	C	2	1.45		1.68	C	2	2.59		7.62
	A:B	2	0.93		1.08	A:B	2	0.12		0.34
	A:C	2	1.36		1.58	A:C	2	0.87		2.57
	B:C	4	0.73		1.68	B:C	4	0.69		4.09
	A:B:C	4	1.77		4.12	A:B:C	4	0.35		2.08
<b>Fiber strength</b>	A	1	3.25		4.58	A	1	0.01		0.02
	B	2	12.14	***	34.22	B	2	1.07		3.80
	C	2	7.60	**	21.43	C	2	2.44		8.66
	A:B	2	1.14		3.21	A:B	2	4.24	*	15.05
	A:C	2	0.09		0.24	A:C	2	1.39		4.94
	B:C	4	0.77		4.36	B:C	4	0.16		1.15
	A:B:C	4	1.17		6.59	A:B:C	4	0.34		2.44

A, Two irrigation levels (full, deficit); B, Three cotton lines (NT, L16, L38); C, Three irrigation protocols (flood, forecast, and soil moisture).

S, Significant difference

Different number of asterisks indicate significant differences among factors following Duncan's multiple range tests at the '\*\*\*\*' 0.1%, '\*\*\*' 1% and '\*\*' 5% level.

**Supplemental Table 3. Effects of treatments on morphological, physiological and yield traits of cotton from three years.**

Traits	Line	Irrigation treatments					
		FFI	FDI	SFI	SDI	EFI	EDI
Plant height (cm)	NT	51.1±5.7 <sup>de</sup>	49.3±6.0 <sup>e</sup>	49.9±5.0 <sup>e</sup>	44.6±6.2 <sup>e</sup>	54.4±7.0 <sup>d</sup>	62.7±7.6 <sup>bc</sup>
	L16	65.2±10.5 <sup>bc</sup>	58.1±7.8 <sup>cd</sup>	63.0±4.8 <sup>bc</sup>	55.5±5.5 <sup>d</sup>	70.1±12.0 <sup>a</sup>	66.5±5.8 <sup>ab</sup>
	L38	62.3±7.8 <sup>c</sup>	58.7±8.5 <sup>cd</sup>	63.9±8.0 <sup>b</sup>	56.3±8.3 <sup>cd</sup>	60.4±3.7 <sup>c</sup>	65.6±8.1 <sup>b</sup>
Leaf area (cm <sup>2</sup> )	NT	48.1±6.5 <sup>c</sup>	52.2±5.0 <sup>bc</sup>	54.6±3.2 <sup>c</sup>	39.9±5.5 <sup>d</sup>	56.1±3.0 <sup>b</sup>	75.0±0.7 <sup>a</sup>
	L16	62.4±0.2 <sup>b</sup>	58.9±3.0 <sup>bc</sup>	66.0±3.3 <sup>bc</sup>	56.6±3.4 <sup>b</sup>	72.4±3.8 <sup>a</sup>	83.4±3.7 <sup>a</sup>
	L38	63.1±5.2 <sup>ab</sup>	59.8±3.1 <sup>b</sup>	66.5±2.1 <sup>dc</sup>	64.7±3.5 <sup>b</sup>	70.6±9.2 <sup>a</sup>	75.6±0.8 <sup>a</sup>
Chlorophyll (SPAD)	NT	48.5±0.4 <sup>a</sup>	52.5±1.1 <sup>c</sup>	53.3±0.3 <sup>b</sup>	55.1±1.6 <sup>b</sup>	50.0±0.3 <sup>d</sup>	50.5±0.6 <sup>d</sup>
	L16	51.8±0.3 <sup>bc</sup>	54.2±2.0 <sup>bc</sup>	55.4±1.5 <sup>a</sup>	60.6±2.5 <sup>a</sup>	50.8±0.8 <sup>d</sup>	51.8±1.4 <sup>bcd</sup>
	L38	49.2±1.6 <sup>d</sup>	52.5±0.9 <sup>cd</sup>	52.1±0.6 <sup>dc</sup>	52.1±0.2 <sup>bc</sup>	47.7±0.6 <sup>c</sup>	48.6±0.6 <sup>dc</sup>
Net biosynthesis (μmol CO <sub>2</sub> m <sup>-2</sup> s <sup>-1</sup> )	NT	29.0±1.1 <sup>bc</sup>	28.4±2.0 <sup>c</sup>	28.9±1.4 <sup>bc</sup>	30.3±1.5 <sup>b</sup>	27.9±0.1 <sup>c</sup>	29.4±1.4 <sup>b</sup>
	L16	30.3±1.0 <sup>ab</sup>	31.0±0.9 <sup>a</sup>	31.5±1.2 <sup>a</sup>	31.6±0.5 <sup>a</sup>	29.8±1.8 <sup>b</sup>	29.7±1.3 <sup>b</sup>
	L38	30.5±1.2 <sup>ab</sup>	29.8±1.7 <sup>b</sup>	29.6±2.5 <sup>b</sup>	27.6±1.9 <sup>c</sup>	30.6±1.1 <sup>ab</sup>	30.1±1.5 <sup>b</sup>
Photosynthetic WUE (μmol CO <sub>2</sub> mmol H <sub>2</sub> O)	NT	48.3±0.6 <sup>bc</sup>	51.9±1.7 <sup>d</sup>	53.5±0.5 <sup>g</sup>	54.3±2.4 <sup>g</sup>	49.8±0.5 <sup>c</sup>	50.2±1.0 <sup>fg</sup>
	L16	51.9±0.4 <sup>a</sup>	53.2±3.0 <sup>c</sup>	54.7±2.3 <sup>f</sup>	59.3±3.7 <sup>e</sup>	50.4±1.2 <sup>b</sup>	51.1±2.1 <sup>f</sup>
	L38	48.4±2.4 <sup>abcd</sup>	52.1±1.4 <sup>d</sup>	51.8±0.8 <sup>g</sup>	52.0±0.3 <sup>g</sup>	48.1±1.0 <sup>c</sup>	48.3±0.9 <sup>fg</sup>
Boll number (per plant)	NT	7.0±0.4 <sup>d</sup>	8.2±0.6 <sup>d</sup>	7.7±0.2 <sup>d</sup>	6.5±0.7 <sup>d</sup>	8.8±0.4 <sup>c</sup>	7.6±0.8 <sup>cd</sup>
	L16	11.0±1.4 <sup>abc</sup>	9.6±0.3 <sup>b</sup>	11.0±0.5 <sup>b</sup>	7.7±0.9 <sup>cd</sup>	9.7±0.9 <sup>b</sup>	12.2±1.1 <sup>a</sup>
	L38	9.8±0.4 <sup>b</sup>	9.5±1.0 <sup>bd</sup>	10.7±0.4 <sup>b</sup>	9.0±0.3 <sup>cd</sup>	10.6±1.0 <sup>b</sup>	8.8±1.3 <sup>bc</sup>
Cotton yield (kg hectare <sup>-1</sup> )	NT	3384.7±493.0 <sup>f</sup>	3227.4±339.4 <sup>f</sup>	2830.0±465.4 <sup>h</sup>	1586.6±114.5 <sup>j</sup>	3025.9±673.6 <sup>f</sup>	2342.5±444.7 <sup>f</sup>
	L16	5528.8±262.1 <sup>a</sup>	4492.1±461.0 <sup>d</sup>	4270.9±844.3 <sup>d</sup>	2777.4±37.3 <sup>i</sup>	4837.9±741.5 <sup>b</sup>	3821.7±288.6 <sup>b</sup>
	L38	4973.1±1033.9 <sup>b</sup>	4758.8±779.1 <sup>c</sup>	4348.5±390.0 <sup>c</sup>	3040.9±284.9 <sup>f</sup>	4413.4±663.9 <sup>c</sup>	2964.1±644.6 <sup>c</sup>
Water use efficiency (kg m <sup>-3</sup> )	NT	0.7±0.2 <sup>d</sup>	0.9±0.2 <sup>bd</sup>	0.8±0.3 <sup>c</sup>	0.6±0.2 <sup>cd</sup>	0.4±0.1 <sup>e</sup>	0.4±0.1 <sup>d</sup>
	L16	1.2±0.1 <sup>a</sup>	1.3±0.2 <sup>ab</sup>	1.2±0.5 <sup>ab</sup>	1.0±0.2 <sup>abc</sup>	0.7±0.1 <sup>d</sup>	0.7±0.1 <sup>c</sup>
	L38	1.1±0.3 <sup>b</sup>	1.4±0.4 <sup>ab</sup>	1.2±0.3 <sup>ab</sup>	1.1±0.3 <sup>abc</sup>	0.6±0.1 <sup>d</sup>	0.5±0.1 <sup>cd</sup>

Full forecast irrigation (FFI); 75% of full forecast irrigation (FDI); full soil moisture irrigation (SFI); 75% of full soil moisture irrigation (SDI); full flood irrigation (EFI); 75% of full flood irrigation (EDI). Different letters indicate significant differences between transgenic lines and NT of the year following Duncan's multiple range tests at the 5% level of significance.