

Supplemental material 1: Raw data

Learning from plant movements triggered by bulliform cells: the biomimetic cellular actuator

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Sesleria nitida

Cell number	Chlorenchyma cell		Aspect ratio [∕] length/width	Chlorenchyma cell
	diameter [μm] length	diameter [μm] width		wall thickness [μm]
1	32.77	16.71	1.96	3.68
2	26.84	17.54	1.53	2.83
3	40.12	14.91	2.69	2.32
4	40.35	18.47	2.18	2.85
5	35.21	15.36	2.29	2.32
6	34.64	18.97	1.83	1.44
7	26.78	16.38	1.63	2.57
8	29.14	15.78	1.85	2.96
9	23.57	17.25	1.37	3.91
10	32.84	13.94	2.36	3.45
11	41.40	14.11	2.93	3.28
12	27.03	23.29	1.16	1.82
13	34.78	17.24	2.02	2.71
14	20.63	25.04	0.82	2.83
15	25.63	19.36	1.32	2.19
16	25.46	21.05	1.21	2.44
17	24.20	17.26	1.40	3.60
18	31.56	23.68	1.33	4.47
19	19.56	26.78	0.73	3.36
20	23.49	22.92	1.02	1.74
21	19.51	19.27	1.01	1.78
22	21.85	25.03	0.87	1.45
23	22.11	15.96	1.39	2.41
24	38.84	19.94	1.95	2.03
25	23.91	22.64	1.06	1.22
26	16.50	30.03	0.55	1.68
27	29.89	20.87	1.43	2.37
28	30.46	21.16	1.44	2.20
29	18.26	20.85	0.88	1.83
30	15.54	20.83	0.75	2.16
31	31.75	16.33	1.94	1.99
32	19.15	12.93	1.48	2.76
33	18.03	19.52	0.92	3.23
34	20.41	21.57	0.95	1.51
35	17.09	20.73	0.82	2.78
36	15.23	30.63	0.50	1.87
37	24.12	15.34	1.57	2.12
38	33.83	15.08	2.24	2.32
39	30.53	21.21	1.44	2.82
40	30.31	15.27	1.98	2.85
41	22.92	16.34	1.40	1.93
42	18.73	26.52	0.71	1.87
43	25.14	16.41	1.53	2.24
44	37.80	20.83	1.81	1.87

45	43.71	21.06	2.08	2.14
46	31.73	20.95	1.51	1.93
47	34.63	17.89	1.94	2.46
48	37.35	20.45	1.83	1.93
49	39.40	20.00	1.97	1.95
50	44.86	28.92	1.55	2.55
Mean	28.19	19.81	1.50	2.42
SD	8.03	4.18	0.56	0.69
Median	26.93	19.73	1.46	2.32
IQR	12.52	4.81	0.91	0.90
Min	15.23	12.93	0.50	1.22
Max	44.86	30.63	2.93	4.47
<i>n</i>	50	50	50	50

Sesleria nitida

Cell number	Bulliform cells	Bulliform cells	Aspect ratio [°]
	diameter [μm]	diameter [μm]	
	length	width	length/width
1	23.20	9.13	2.54
2	44.31	7.02	6.32
3	62.56	8.35	7.49
4	76.51	11.22	6.82
5	78.43	8.75	8.96
6	74.15	14.11	5.26
7	65.79	13.82	4.76
8	52.25	10.54	4.96
9	35.43	5.08	6.97
10	19.71	9.02	2.18
11	27.43	8.13	3.37
12	42.63	5.92	7.20
13	54.55	12.44	4.39
14	59.63	11.32	5.27
15	59.67	14.41	4.14
16	48.38	13.11	3.69
17	35.34	10.19	3.47
18	25.82	12.48	2.07
19	49.04	7.47	6.56
Mean	49.20	10.13	5.07
SD	18.18	2.80	1.95
Median	49.04	10.19	4.96
IQR	25.73	4.21	3.11
Min	19.71	5.08	2.07
Max	78.43	14.41	8.96
n	19	19	19

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Bulliform cells: cell wall thickness [μm]		
#	abaxial and mediolateral	adaxial
1	1.29	3.16
2	1.16	3.64
3	1.16	3.25
4	1.09	3.21
5	0.90	3.25
6	0.81	3.55
7	1.08	3.55
8	0.95	3.91
9	1.13	4.04
10	0.99	4.02
11	0.75	3.28
12	0.98	2.47
13	1.00	2.58
14	1.16	2.97
15	1.01	2.73
16	0.86	2.55
17	0.87	2.97
18	0.83	3.00
19	0.66	3.16
20	0.90	2.93
21	0.97	2.72
22	1.03	2.79
23	0.84	3.12
24	1.02	3.74
25	0.98	2.82
Mean	0.98	3.18
SD	0.15	0.45
Median	0.98	3.16
IQR	0.23	0.79
Min	0.66	2.47
Max	1.29	4.04
<i>n</i>	25	25

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Sample number	opening angle [°]	opening angle [°]	Difference [°]
status	fresh	dried	
1	79.79	25.23	54.56
2	94.34	18.89	75.45
3	82.43	24.63	57.79
4	82.48	23.88	58.60
5	94.70	71.50	23.20
6	96.65	18.67	77.98
7	72.60	21.09	51.50
8	96.80	55.37	41.43
9	109.19	65.47	43.72
10	97.33	38.30	59.04
Mean	90.63	36.30	54.33
SD	10.91	20.32	16.03
Median	94.52	24.93	56.17
IQR	14.32	29.31	13.26
Min	72.60	18.67	23.20
Max	109.19	71.50	77.98
n	10	10	10

Sesleria nitida

Hoop stress	$\sigma_H = (P \cdot d) / (2 \cdot t)$	
t [m]	0.00000098	
dmaj [m]	4.92E-05	2.9665E-05 dmean
dmin [m]	1.013E-05	
Pturg [Pa]	450000	
Pdehyd [Pa]	380000	
Hturg [MPa]		6.81
Hdehyd [MPa]		5.75

Simulation opening angle (Figure 5)

internal cell pressure [MPa]	change in opening angle [°]
3.50E-03	3.052
3.97E-03	3.472
4.43E-03	3.897
5.13E-03	4.543
6.18E-03	5.528
7.23E-03	6.519
8.28E-03	7.504
9.33E-03	8.478
1.04E-02	9.437
1.14E-02	10.378
1.25E-02	11.301
1.35E-02	12.204
1.46E-02	13.086
1.56E-02	13.950
1.72E-02	15.217
1.88E-02	16.453
2.04E-02	17.664
2.19E-02	18.855
2.35E-02	20.030
2.59E-02	21.766
2.82E-02	23.474
3.17E-02	25.968
3.52E-02	28.433
3.87E-02	30.877
4.22E-02	33.307
4.57E-02	35.742
4.92E-02	38.179
5.27E-02	40.628
5.62E-02	43.101
5.97E-02	45.607
6.32E-02	48.131
6.67E-02	50.665
6.79E-02	51.497
6.90E-02	52.321
7.00E-02	53.030

Simulation opening angle (Figure 8)

internal cell pressure [MPa]	vertical sidewall angle [°]
0.00125	0.370715095
0.00250	0.729857785
0.00375	1.078044032
0.00500	1.415869922
0.00625	1.744000231
0.00750	2.062767498
0.00875	2.372767505
0.01000	2.674347978
0.01125	2.967970404
0.01250	3.253989635
0.01375	3.532759876
0.01500	3.80463483
0.01625	4.069835255
0.01750	4.328669857
0.01875	4.581447093
0.02000	4.82816564
0.02125	5.069620076
0.02250	5.305322033
0.02375	5.536110379
0.02500	5.761495954