

## Electronic supplement to:

### **Cytotaxonomy of *Kaempferia* subg. *Protanthium* (*Zingiberaceae*) supports a new limestone species endemic to Thailand**

**Nattapon Nopporncharoenkul, Wiphada Sukseansri, Possathorn Nopun, Jiraporn Meewasana, Thaya Jenjittikul, Ngarmnij Chuenboonngarm, Unchera Viboonjun & Puangpaka Umpunjun**

Electronic supplement to: Nopporncharoenkul N., Sukseansri W., Nopun P., Meewasana J., Jenjittikul T., Chuenboonngarm N., Viboonjun U. & Umpunjun P. 2024: Cytotaxonomy of *Kaempferia* subg. *Protanthium* (*Zingiberaceae*) supports a new limestone species endemic to Thailand. – *Willdenowia* 54: 121–149. <https://doi.org/10.3372/wi.54.54201>

#### Contents

Appendix S1	page
Fig. S1 .....	S-2
Table S1 .....	S-3
<b>Appendix S2</b>	
Table S2 .....	S-8
<b>Appendix S3</b>	
Table S3 .....	S-13
Table S4 .....	S-14

**Appendix S1.** List of accessions, localities and specimen references included in genome size and mitotic chromosome analyses.

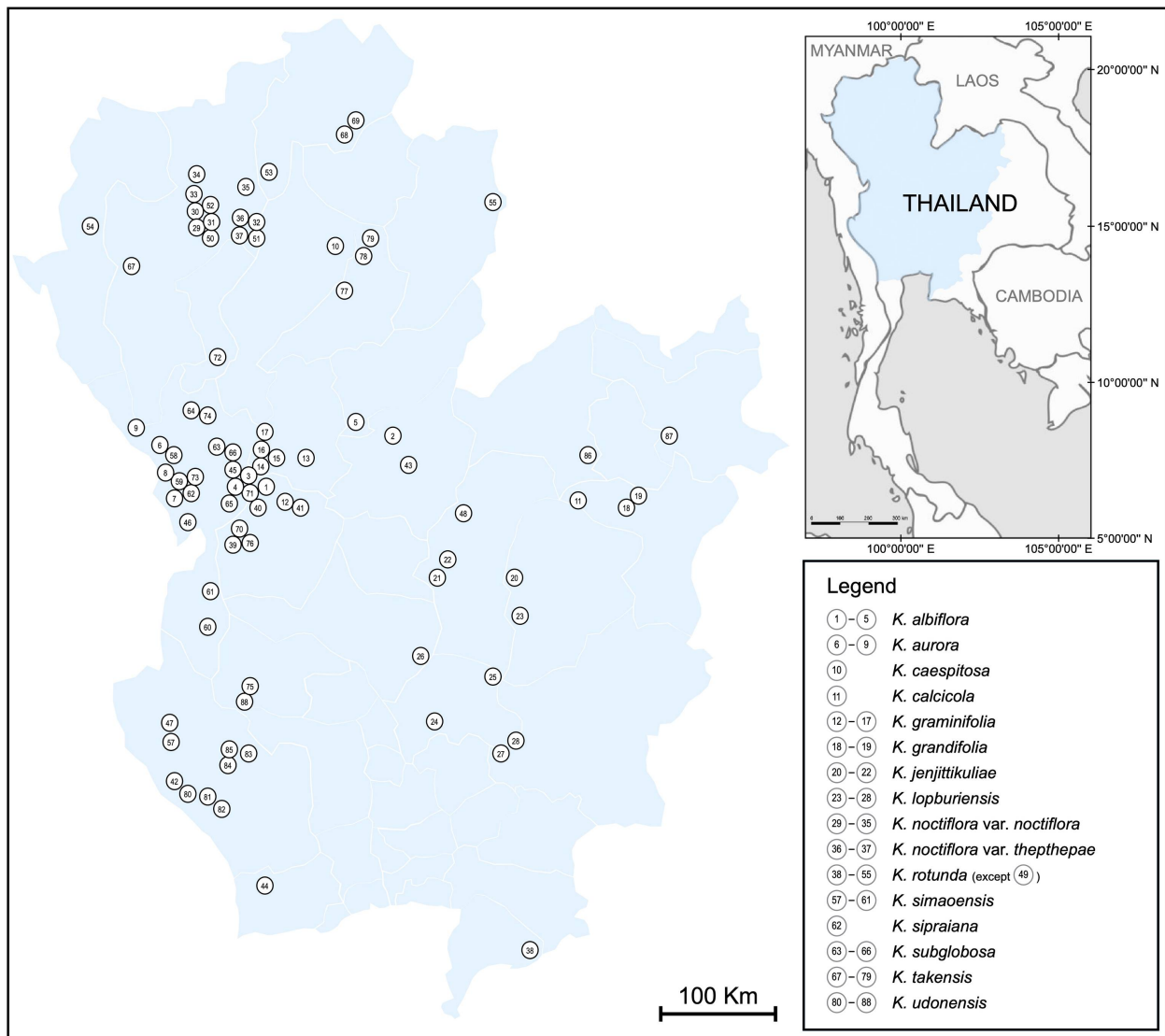


Fig. S1. Distribution map of accessions of species belonging to *Kaempferia* subg. *Proanthium* in Thailand included in genome size and mitotic chromosome analyses. Each point represents an individual collecting site of accession. Two accessions of *K. rotunda* (no. 49 and 56), which were introduced from Laos, were not included in a map.

Table S1. List of accessions and specimen references included in genome size and mitotic chromosome analyses. Order (No.) of each accession refers to an individual collecting site of distribution map in Fig. S1.

No.	Specimens
<b><i>Kaempferia albiflora</i></b> Jenjitt. & Ruchis.	
1	Thailand, Kamphaeng Phet province, Phran Kratai district, 3 May 2018, <i>N. Nopporncharoenkul NNSB-634</i> (QBG)
2	Thailand, Phitsanulok province, Wat Bot district, 13 Jun 2019, <i>N. Nopporncharoenkul NNSB-741</i> (SLR, flowers preserved in spirit)
3	Thailand, Tak province, Mueang Tak district, Wang Prachop, 1 Jun 2017, <i>N. Nopporncharoenkul NNSB-546</i> (QBG)
4	Thailand, Tak province, Mueang Tak district, Ban Lan Theng, 20 May 2019, <i>N. Nopporncharoenkul NNSB-716</i> (QBG)
5	Thailand, Uttaradit province, Phichai district, Tha Sak, 22 Apr 2017, <i>N. Nopporncharoenkul NNSB-532</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia aurora</i></b> Noppornch. & Jenjitt.	
6	Thailand, Tak province, Mae Ramat district, 10 May 2021, <i>N. Nopporncharoenkul NNSB-855</i> (SLR, flowers preserved in spirit)
7	Thailand, Tak province, Mae Sot district, 24 May 2017, <i>N. Nopporncharoenkul NNSB-545</i> (SLR, flowers preserved in spirit)
8	Thailand, Tak province, Mae Sot district, Mae Ka Sa Waterfall, 20 May 2019, <i>N. Nopporncharoenkul NNSB-713</i> (QBG, including flowers preserved in spirit as part of a single specimen)
9	Thailand, Tak province, Tha Song Yang district, Mae Song, 7 May 2020, <i>N. Nopporncharoenkul NNSB-757</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia caespitosa</i></b> Noppornch. & Jenjitt.	
10	Thailand, Lampang province, Ngao district, 28 May 2019, <i>N. Nopporncharoenkul NNSB-733</i> (QBG)
<b><i>Kaempferia calcicola</i></b> Noppornch.	
11	Thailand, Khon Kaen province, Phu Pha Man district, Na Fai, 27 Apr 2023, <i>N. Nopporncharoenkul NNSB-903</i> (QBG, including flowers preserved in spirit as part of a single specimen)
<b><i>Kaempferia graminifolia</i></b> Noppornch. & Jenjitt.	
12	Thailand, Kamphaeng Phet province, Phran Kratai district, 27 Sep 2018, <i>N. Nopporncharoenkul NNSB-686</i> (QBG)
13	Thailand, Sukhothai province, Mueang Sukhothai district, Mueang Kao, 27 Jan 2017, <i>N. Nopporncharoenkul NNSB-516</i> (SLR, flowers preserved in spirit)
14	Thailand, Sukhothai province, Ban Dan Lan Hoi district, 17 Oct 2016, <i>N. Nopporncharoenkul NNSB-499</i> (QBG)
15	Thailand, Sukhothai province, Ban Dan Lan Hoi district, 19 Oct 2017, <i>N. Nopporncharoenkul NNSB-594</i> (SLR, flowers preserved in spirit)
16	Thailand, Sukhothai province, Ban Dan Lan Hoi district, 14 Jun 2018, <i>N. Nopporncharoenkul NNSB-657</i> (SLR, flowers preserved in spirit)
17	Thailand, Sukhothai province, Ban Dan Lan Hoi district, 26 Sep 2018, <i>N. Nopporncharoenkul NNSB-684</i> (SLR, flowers preserved in spirit)

No.	Specimens
<b><i>Kaempferia grandifolia</i></b> Saensouk & Jenjitt.	
18	Thailand, Khon Kaen province, Phu Wiang district, Mueang Kao Phatthana, Khok Phu Taka, 28 Feb 2015, <i>N. Nopporncharoenkul NNSB-320</i> (SLR, flowers preserved in spirit)
19	Thailand, Khon Kaen province, Phu Wiang district, Mueang Kao Phatthana, Khok Phu Taka, 6 Mar 2017, <i>N. Nopporncharoenkul NNSB-519</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia jenjittikuliae</i></b> Noppornch.	
20	Thailand, Chaiyaphum province, Phakdi Chumphon district, 8 Jul 2020, <i>N. Nopporncharoenkul NNSB-802</i> (SLR, flowers preserved in spirit)
21	Thailand, Phetchabun province, Chon Daen district, Sap Phutsa, 19 May 2020, <i>N. Nopporncharoenkul NNSB-760</i> (QBG, including flowers preserved in spirit as part of a single specimen)
22	Thailand, Phetchabun province, Chon Daen district, Phutthabat, 15 Sep 2020, <i>N. Nopporncharoenkul NNSB-836</i> (QBG)
<b><i>Kaempferia lopburiensis</i></b> Picheans.	
23	Thailand, Chaiyaphum province, Thep Sathit district, Huai Yai Chio, 21 May 2020, <i>N. Nopporncharoenkul NNSB-755</i> (SLR, flowers preserved in spirit)
24	Thailand, Lopburi province, Mueang Lopburi district, Weluwan Temple (Khao Chin Lae), 20 May 2017, <i>N. Nopporncharoenkul NNSB-541</i> (QBG)
25	Thailand, Lopburi province, Lam Sonthi district, Khiri Bua Wanaram Temple, 18 May 2015, <i>N. Nopporncharoenkul NNSB-335</i> (SLR, flowers preserved in spirit)
26	Thailand, Nakhon Sawan province, Phaisali district, 24 May 2017, <i>N. Nopporncharoenkul NNSB-544</i> (SLR, flowers preserved in spirit)
27	Thailand, Saraburi province, Muak Lek district, 30 May 2018, <i>N. Nopporncharoenkul NNSB-652</i> (SLR, flowers preserved in spirit)
28	Thailand, Saraburi province, Muak Lek district, 29 Jun 2018, <i>N. Nopporncharoenkul NNSB-665</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia noctiflora</i></b> Noppornch. & Jenjitt. var. <i>noctiflora</i>	
29	Thailand, Chiang Mai province, Mueang Chiang Mai district, Wat Pha Lat Hike, 10 May 2018, <i>N. Nopporncharoenkul NNSB-640</i> (SLR, flowers preserved in spirit)
30	Thailand, Chiang Mai province, Mueang Chiang Mai district, Wang Bua Ban Waterfall, 26 May 2019, <i>N. Nopporncharoenkul NNSB-725</i> (SLR, flowers preserved in spirit)
31	Thailand, Chiang Mai province, Mueang Chiang Mai district, Huai Tueng Thao, 13 Jun 2016, <i>N. Nopporncharoenkul NNSB-468</i> (SLR, flowers preserved in spirit)
32	Thailand, Chiang Mai province, Mae On district, Ban Sahakorn, 24 Jun 2017, <i>N. Nopporncharoenkul NNSB-554</i> (BKF)
33	Thailand, Chiang Mai province, Mae Rim district, Huai Sai, 26 Apr 2018, <i>N. Nopporncharoenkul NNSB-625</i> (SLR, flowers preserved in spirit)
34	Thailand, Chiang Mai province, Mae Taeng district, Kuet Chang, 6 May 2019, <i>N. Nopporncharoenkul NNSB-708</i> (SLR, flowers preserved in spirit)
35	Thailand, Chiang Mai province, Phrao district, 30 May 2018, <i>N. Nopporncharoenkul NNSB-653</i> (SLR, flowers preserved in spirit)

No.	Specimens
<b><i>Kaempferia noctiflora</i> var. <i>thepthepae</i> Noppornch. &amp; Somnoo</b>	
36	Thailand, Chiang Mai province, Doi Saket district, Mae Pong, 20 Jun 2023, <i>N. Nopporncharoenkul NNSB-928</i> (QBG, including flowers preserved in spirit as part of a single specimen)
37	Thailand, Chiang Mai province, San Kamphaeng district, Huai Sai, 24 Oct 2023, <i>N. Nopporncharoenkul NNSB-953</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia rotunda</i> L.</b>	
38	Thailand, Chonburi province, Bo Thong district, Ang Pak Nam Waterfall, 23 Apr 2018, <i>N. Nopporncharoenkul NNSB-623</i> (SLR, flowers preserved in spirit)
39	Thailand, Kamphaeng Phet province, Khlong Lan district, 29 May 2018, <i>N. Nopporncharoenkul NNSB-664</i> (SLR, flowers preserved in spirit)
40	Thailand, Kamphaeng Phet province, Kosamphi Nakhon district, 8 Apr 2019, <i>N. Nopporncharoenkul NNSB-698</i> (SLR, flowers preserved in spirit)
41	Thailand, Kamphaeng Phet province, Phran Kratai district, 21 May 2019, <i>N. Nopporncharoenkul NNSB-718</i> (SLR, flowers preserved in spirit)
42	Thailand, Kanchanaburi province, Sai Yok district, Khao Wang Khamen, 30 Jul 2017, <i>N. Nopporncharoenkul NNSB-567</i> (SLR, flowers preserved in spirit)
43	Thailand, Phitsanulok province, Wang Thong district, 29 May 2018, <i>N. Nopporncharoenkul NNSB-660</i> (SLR, flowers preserved in spirit)
44	Thailand, Ratchaburi province, Suan Phueng district, 8 Oct 2014, <i>N. Nopporncharoenkul NNSB-282</i> (SLR, flowers preserved in spirit)
45	Thailand, Tak province, Mueang Tak district, Kao Pramuan, 30 Apr 2017, <i>N. Nopporncharoenkul NNSB-534</i> (SLR, flowers preserved in spirit)
46	Thailand, Tak province, Phop Phra district, 15 Apr 2014, <i>N. Nopporncharoenkul NNSB-163</i> (SLR, flowers preserved in spirit)
47	Thailand, Kanchanaburi province, Thong Pha Phum district, 29 Apr 2018, <i>N. Nopporncharoenkul NNSB-629</i> (SLR, flowers preserved in spirit)
48	Thailand, Phetchabun province, Khao Kho district, 5 Apr 2018, <i>N. Nopporncharoenkul NNSB-602</i> (SLR, flowers preserved in spirit)
49	Laos, Champasak province, <i>s.n.</i> , 3 Apr 2018, <i>N. Nopporncharoenkul NNSB-600-1</i> (SLR, flowers preserved in spirit)
50	Thailand, Chiang Mai province, Mueang Chiang Mai district, Wang Bua Ban Waterfall, 10 May 2018, <i>N. Nopporncharoenkul NNSB-642</i> (SLR, flowers preserved in spirit)
51	Thailand, Chiang Mai province, Mae On district, Ban Sahakorn, 25 May 2019, <i>N. Nopporncharoenkul NNSB-722</i> (SLR, flowers preserved in spirit)
52	Thailand, Chiang Mai province, Mae Rim district, Huai Sai, 29 Apr 2019, <i>N. Nopporncharoenkul NNSB-703</i> (SLR, flowers preserved in spirit)
53	Thailand, Chiang Rai province, Wiang Pa Pao district, 16 May 2017, <i>N. Nopporncharoenkul NNSB-540</i> (SLR, flowers preserved in spirit)
54	Thailand, Mae Hong Son province, Khun Yuam district, 22 Nov 2015, <i>N. Nopporncharoenkul NNSB-588</i> (SLR, flowers preserved in spirit)
55	Thailand, Nan province, Bo Kluea district, Huai Tee Waterfall, 29 Mar 2017, <i>N. Nopporncharoenkul NNSB-522</i> (SLR, flowers preserved in spirit)

No.	Specimens
<b><i>Kaempferia rotunda</i></b> (continued)	
56	Laos, Champasak province, <i>s.n.</i> , 3 Apr 2018, <i>N. Nopporncharoenkul NNSB-600-2</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia simaoensis</i></b> Y. Y. Qian	
57	Thailand, Kanchanaburi province, Thong Pha Phum district, Huai U Long, 5 May 2017, <i>N. Nopporncharoenkul NNSB-535</i> (QBG)
58	Thailand, Tak province, Mae Ramat district, 14 Jun 2018, <i>N. Nopporncharoenkul NNSB-655</i> (SLR, flowers preserved in spirit)
59	Thailand, Tak province, Mae Sot district, Phawo, 20 Apr 2018, <i>N. Nopporncharoenkul NNSB-613</i> (QBG)
60	Thailand, Tak province, Umphang district, Ban Sepala, 1 Sep 2018, <i>N. Nopporncharoenkul NNSB-676</i> (SLR, flowers preserved in spirit)
61	Thailand, Tak province, Umphang district, Doi Hua Mot, 2 Sep 2018, <i>N. Nopporncharoenkul NNSB-678</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia sipraiana</i></b> Boonma & Seansouk	
62	Thailand, Tak province, Mae Sot district, Huai Ya U, 14 Jun 2018, <i>N. Nopporncharoenkul NNSB-656</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia subglobosa</i></b> Noppornch. & Jenjitt.	
63	Thailand, Tak province, Ban Tak district, Thung Kracho, 11 Sep 2019, <i>N. Nopporncharoenkul NNSB-749</i> (QBG, including flowers preserved in spirit as part of a single specimen)
64	Thailand, Tak province, Sam Ngao district, Bhumibol Dam, 10 Sep 2019, <i>N. Nopporncharoenkul NNSB-746</i> (SLR, flowers preserved in spirit)
65	Thailand, Tak province, Wang Chao district, 29 May 2018, <i>N. Nopporncharoenkul NNSB-662</i> (SLR, flowers preserved in spirit)
66	Thailand, Tak province, <i>s.n.</i> , 18 Sep 2019, <i>N. Nopporncharoenkul NNSB-751</i> (SLR, flowers preserved in spirit)
<b><i>Kaempferia takensis</i></b> Boonma & Saensouk	
67	Thailand, Chiang Mai province, Mae Cham district, 14 May 2019, <i>N. Nopporncharoenkul NNSB-737</i> (SLR, flowers preserved in spirit)
68	Thailand, Chiang Rai province, Thoeng district, Si Don Chai, 20 Apr 2017, <i>N. Nopporncharoenkul NNSB-531</i> (SLR, flowers preserved in spirit)
69	Thailand, Chiang Rai province, Thoeng district, Phra That Pu Long, 7 Apr 2019, <i>N. Nopporncharoenkul NNSB-696</i> (SLR, flowers preserved in spirit)
70	Thailand, Kamphaeng Phet province, Khlong Lan district, 6 Apr 2017, <i>N. Nopporncharoenkul NNSB-526-1</i> (QBG)
71	Thailand, Kamphaeng Phet province, Kosamphi Nakhon district, 2 Sep 2018, <i>N. Nopporncharoenkul NNSB-697</i> (QBG)
72	Thailand, Lamphun province, Li district, 15 Aug 2020, <i>N. Nopporncharoenkul NNSB-827</i> (SLR, flowers preserved in spirit)
73	Thailand, Tak province, Mae Sot district, Doi Ruak, 19 Oct 2017, <i>N. Nopporncharoenkul NNSB-595</i> (SLR, flowers preserved in spirit)

No.	Specimens
<b><i>Kaempferia takensis</i></b> (continued)	
74	Thailand, Tak province, Sam Ngao district, Bhumibol Dam, 10 Sep 2019, <i>N. Nopporncharoenkul</i> NNSB-754 (SLR, flowers preserved in spirit)
75	Thailand, Uthai Thani province, Ban Rai district, 22 Jul 2017, <i>N. Nopporncharoenkul</i> NNSB-598 (SLR, flowers preserved in spirit)
76	Thailand, Kamphaeng Phet province, Khlong Lan district, 6 Apr 2017, <i>N. Nopporncharoenkul</i> NNSB-526-2 (SLR, flowers preserved in spirit)
77	Thailand, Phrae province, Long district, 5 Apr 2019, <i>N. Nopporncharoenkul</i> NNSB-690 (SLR, flowers preserved in spirit)
78	Thailand, Phrae province, Song district, Mae Yom National Park, 5 Apr 2017, <i>N. Nopporncharoenkul</i> NNSB-524 (QBG)
79	Thailand, Phrae province, Song district, Mae Yom National Park, 6 Apr 2019, <i>N. Nopporncharoenkul</i> NNSB-692 (SLR, flowers preserved in spirit)
<b><i>Kaempferia udonensis</i></b> Pichens. & Phokham	
80	Thailand, Kanchanaburi province, Sai Yok district, Hellfire Pass, 30 Nov 2016, <i>N. Nopporncharoenkul</i> NNSB-508 (QBG)
81	Thailand, Kanchanaburi province, Sai Yok district, Phu Ong Ka, 30 Apr 2018, <i>N. Nopporncharoenkul</i> NNSB-633 (SLR, flowers preserved in spirit)
82	Thailand, Kanchanaburi province, Sai Yok district, 1 Jun 2019, <i>N. Nopporncharoenkul</i> NNSB-736 (SLR, flowers preserved in spirit)
83	Thailand, Kanchanaburi province, Si Sawat district, 2 May 2019, <i>N. Nopporncharoenkul</i> NNSB-707 (SLR, flowers preserved in spirit)
84	Thailand, Kanchanaburi province, Si Sawat district, Srinakarin Dam, 10 Sep 2019, <i>N. Nopporncharoenkul</i> NNSB-747 (SLR, flowers preserved in spirit)
85	Thailand, Kanchanaburi province, Si Sawat district, Srinakarin Dam, 10 Sep 2019, <i>N. Nopporncharoenkul</i> NNSB-753 (SLR, flowers preserved in spirit)
86	Thailand, Loei province, Pha Khao district, 3 Nov 2018, <i>N. Nopporncharoenkul</i> NNSB-687 (SLR, flowers preserved in spirit)
87	Thailand, Udon Thani province, Nong Wua So district, 25 Mar 2018, <i>N. Nopporncharoenkul</i> NNSB-599 (SLR, flowers preserved in spirit)
88	Thailand, Uthai Thani province, Ban Rai district, 27 Sep 2019, <i>N. Nopporncharoenkul</i> NNSB-752 (SLR, flowers preserved in spirit)

**Appendix S2** (Table S2). Means with standard deviations (S.D.) of estimated genome sizes of individual plants included in genome size analysis. Each individual plant was re-analysed three times (three replicates) on different days.

Species	Accession numbers	Locality	Mean genome size (pg) ± S.D.				
			Plant 1	Plant 2	Plant 3	Plant 4	Plant 5
<i>Kaempferia albiflora</i> Jenjitt. & Ruchis.	NNSB634	Thailand, Kamphaeng Phet, Phran Kratai	5.646 ± 0.011	5.833 ± 0.020	5.724 ± 0.007	6.013 ± 0.028	6.037 ± 0.015
	NNSB741	Thailand, Phitsanulok, Wat Bot	6.368 ± 0.020	6.516 ± 0.024	6.377 ± 0.028	6.387 ± 0.020	
	NNSB546	Thailand, Tak, Amphoe Mueang	5.867 ± 0.013	5.839 ± 0.020	5.898 ± 0.010	5.745 ± 0.027	5.841 ± 0.021
	NNSB716	Thailand, Tak, Amphoe Mueang	6.013 ± 0.016	6.198 ± 0.019	6.120 ± 0.019		
	NNSB532	Thailand, Uttaradit, Phichai	6.249 ± 0.022	6.222 ± 0.013	6.065 ± 0.024	6.046 ± 0.012	5.992 ± 0.018
<i>K. aurora</i> Noppornch. & Jenjitt.	NNSB855	Thailand, Tak, Mae Ramat	5.242 ± 0.013	5.262 ± 0.018	5.111 ± 0.022		
	NNSB545	Thailand, Tak, Mae Sot	5.362 ± 0.021	5.319 ± 0.014	5.319 ± 0.011		
	NNSB713	Thailand, Tak, Mae Sot	5.494 ± 0.012	5.317 ± 0.020	5.396 ± 0.023		
	NNSB757	Thailand, Tak, Tha Song Yang	5.408 ± 0.014	5.229 ± 0.015			
<i>K. caespitosa</i> Noppornch. & Jenjitt.	NNSB733	Thailand, Lampang, Ngao	4.251 ± 0.018	4.313 ± 0.010	4.293 ± 0.013		
<i>K. calcicola</i> Noppornch.	NNSB903	Thailand, Khon Kaen, Phu Pha Man	6.291 ± 0.021	6.136 ± 0.022	6.354 ± 0.014	6.169 ± 0.025	6.324 ± 0.019
<i>K. graminifolia</i> Noppornch. & Jenjitt.	NNSB686	Thailand, Kamphaeng Phet, Phran Kratai	5.920 ± 0.024	5.926 ± 0.023	5.926 ± 0.013	5.934 ± 0.019	
	NNSB516	Thailand, Sukhothai, Amphoe Mueang	5.990 ± 0.043				
	NNSB499	Thailand, Sukhothai, Ban Dan Lan Hoi	6.084 ± 0.022				
	NNSB594	Thailand, Sukhothai, Ban Dan Lan Hoi	5.956 ± 0.017	5.923 ± 0.024	5.950 ± 0.013	5.999 ± 0.028	6.121 ± 0.022
	NNSB657	Thailand, Sukhothai, Ban Dan Lan Hoi	5.935 ± 0.019	5.940 ± 0.027	5.925 ± 0.022	5.900 ± 0.025	5.979 ± 0.021
NNSB684	Thailand, Sukhothai, Ban Dan Lan Hoi	5.973 ± 0.016	5.868 ± 0.021	6.119 ± 0.019	6.062 ± 0.025		
<i>K. grandifolia</i> Saensouk & Jenjitt.	NNSB320	Thailand, Khon Kaen, Phu Wiang	5.709 ± 0.011	5.707 ± 0.015	5.753 ± 0.023	5.755 ± 0.013	
	NNSB519	Thailand, Khon Kaen, Phu Wiang	5.658 ± 0.019	5.682 ± 0.012	5.684 ± 0.018	5.490 ± 0.011	5.655 ± 0.024



Species	Accession numbers	Locality	Mean genome size (pg) ± S.D.				
			Plant 1	Plant 2	Plant 3	Plant 4	Plant 5
<i>Kaempferia jenjittikuliae</i> Noppornch.	NNSB802	Thailand, Chaiyaphum, Phakdi Chumphon	5.370 ± 0.025	5.382 ± 0.011	5.494 ± 0.012		
	NNSB760	Thailand, Phetchabun, Chon Daen	5.471 ± 0.023	5.263 ± 0.025	5.266 ± 0.014		
	NNSB836	Thailand, Phetchabun, Chon Daen	5.351 ± 0.010	5.381 ± 0.012	5.295 ± 0.012	5.364 ± 0.027	
<i>K. lopburiensis</i> Picheans.	NNSB755	Thailand, Chaiyaphum, Thep Sathit	4.962 ± 0.023	4.923 ± 0.014	4.904 ± 0.022		
	NNSB541	Thailand, Lopburi, Amphoe Mueang	5.465 ± 0.024	5.501 ± 0.017	5.431 ± 0.012	5.376 ± 0.014	5.452 ± 0.022
	NNSB335	Thailand, Lopburi, Lam Sonthi	–				
	NNSB544	Thailand, Nakhon Sawan, Phaisali	4.875 ± 0.014	4.878 ± 0.023	4.903 ± 0.019	4.858 ± 0.018	4.906 ± 0.011
	NNSB652	Thailand, Saraburi, Muak Lek	5.027 ± 0.017	5.450 ± 0.025	5.048 ± 0.012	5.377 ± 0.014	5.210 ± 0.019
	NNSB665	Thailand, Saraburi, Muak Lek	5.254 ± 0.013				
	NNSB640	Thailand, Chiang Mai, Amphoe Mueang	4.646 ± 0.013	4.671 ± 0.011	4.729 ± 0.027		
<i>K. noctiflora</i> Noppornch. & Jenjitt. var. <i>noctiflora</i>	NNSB725	Thailand, Chiang Mai, Amphoe Mueang	4.745 ± 0.011	4.773 ± 0.017	4.736 ± 0.013		
	NNSB468	Thailand, Chiang Mai, Amphoe Mueang	–				
	NNSB554	Thailand, Chiang Mai, Mae On	4.659 ± 0.018	4.731 ± 0.014	4.788 ± 0.010	4.654 ± 0.024	4.684 ± 0.009
	NNSB625	Thailand, Chiang Mai, Mae Rim	4.659 ± 0.021	4.713 ± 0.023	4.670 ± 0.012	4.710 ± 0.017	
	NNSB708	Thailand, Chiang Mai, Mae Taeng	4.806 ± 0.011	4.742 ± 0.011	4.782 ± 0.024		
	NNSB653	Thailand, Chiang Mai, Phrao	4.586 ± 0.022	4.616 ± 0.026	4.665 ± 0.024	4.710 ± 0.015	
	NNSB928	Thailand, Chiang Mai, Doi Saket	4.625 ± 0.012	4.688 ± 0.021	4.679 ± 0.017		
<i>K. noctiflora</i> var. <i>thepthepae</i> Noppornch. & Somnoo	NNSB953	Thailand, Chiang Mai, San Kamphaeng	4.857 ± 0.017	4.869 ± 0.015	4.819 ± 0.019	4.773 ± 0.023	4.779 ± 0.014
	NNSB623	Thailand, Chonburi, Bo Thong	4.213 ± 0.018				
<i>K. rotunda</i> L.	NNSB664	Thailand, Kamphaeng Phet, Khlong Lan	4.244 ± 0.023	4.196 ± 0.019	4.273 ± 0.011	4.260 ± 0.026	

Species	Accession numbers	Locality	Mean genome size (pg) ± S.D.					
			Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	
<i>Kaempferia rotunda</i> (continued)	NNSB698	Thailand, Kamphaeng Phet, Kosamphi Nakhon	4.106 ± 0.023	4.040 ± 0.019	4.068 ± 0.020			
	NNSB718	Thailand, Kamphaeng Phet, Phran Kratai	4.099 ± 0.026	4.103 ± 0.023	4.149 ± 0.028			
	NNSB567	Thailand, Kanchanaburi, Sai Yok	4.247 ± 0.019	4.296 ± 0.021	4.344 ± 0.013			
	NNSB660	Thailand, Phitsanulok, Wang Thong	4.281 ± 0.023	4.247 ± 0.021				
	NNSB282	Thailand, Ratchaburi, Suan Phueng	–					
	NNSB534	Thailand, Tak, Amphoe Mueang	4.124 ± 0.013	4.235 ± 0.011	4.138 ± 0.022			
	NNSB163	Thailand, Tak, Phop Phra	–					
	NNSB629	Thailand, Kanchanaburi, Thong Pha Phum	6.652 ± 0.023	7.080 ± 0.025	7.069 ± 0.020			
	NNSB602	Thailand, Phetchabun, Khao Kho	7.194 ± 0.014	7.118 ± 0.023				
	NNSB600–1	Laos, Champasak	6.787 ± 0.035					
	NNSB642	Thailand, Chiang Mai, Amphoe Mueang	8.225 ± 0.015	8.006 ± 0.024	8.496 ± 0.028			
	NNSB722	Thailand, Chiang Mai, Mae On	7.961 ± 0.022	8.193 ± 0.010	8.340 ± 0.022			
	NNSB703	Thailand, Chiang Mai, Mae Rim	8.467 ± 0.020	8.243 ± 0.019				
	NNSB540	Thailand, Chiang Rai, Wiang Pa Pao	8.414 ± 0.015	8.281 ± 0.019				
	NNSB588	Thailand, Mae Hong Son, Khun Yuam	9.186 ± 0.018	9.094 ± 0.022				
	NNSB522	Thailand, Nan, Bo Kluea	8.647 ± 0.013	8.788 ± 0.016				
	NNSB600–2	Laos, Champasak	9.365 ± 0.025	8.979 ± 0.021				
	<i>K. simaoensis</i> Y. Y. Qian	NNSB535	Thailand, Kanchanaburi, Thong Pha Phum	4.065 ± 0.015	4.012 ± 0.013	4.051 ± 0.011		
		NNSB655	Thailand, Tak, Mae Ramat	3.875 ± 0.014	3.800 ± 0.011			
NNSB613		Thailand, Tak, Mae Sot	3.886 ± 0.013	3.874 ± 0.015	3.984 ± 0.012			

Species	Accession numbers	Locality	Mean genome size (pg) ± S.D.				
			Plant 1	Plant 2	Plant 3	Plant 4	Plant 5
<i>Kaempferia simaoensis</i> (continued)	NNSB676	Thailand, Tak, Umphang	3.732 ± 0.016	3.631 ± 0.015	3.699 ± 0.011		
	NNSB678	Thailand, Tak, Umphang	3.744 ± 0.014	3.764 ± 0.011	3.804 ± 0.015		
<i>K. sipraiana</i> Boonma & Seansouk	NNSB656	Thailand, Tak, Mae Sot	4.940 ± 0.021	4.807 ± 0.016	5.121 ± 0.025		
<i>K. subglobosa</i> Noppornch. & Jenjitt.	NNSB749	Thailand, Tak, Ban Tak	4.720 ± 0.018	4.703 ± 0.023	4.613 ± 0.019	4.569 ± 0.010	4.489 ± 0.019
	NNSB746	Thailand, Tak, Sam Ngao	4.738 ± 0.016	4.724 ± 0.011	4.712 ± 0.013		
	NNSB662	Thailand, Tak, Wang Chao	4.754 ± 0.027	4.635 ± 0.015	4.661 ± 0.020	4.648 ± 0.022	
	NNSB751	Thailand, Tak, Unknown	4.635 ± 0.021	4.650 ± 0.015	4.581 ± 0.020		
<i>K. takensis</i> Boonma & Saensouk	NNSB737	Thailand, Chiang Mai, Mae Cham	5.046 ± 0.023	5.081 ± 0.025	5.019 ± 0.019		
	NNSB531	Thailand, Chiang Rai, Thoeng	4.600 ± 0.012	4.640 ± 0.010	4.498 ± 0.019		
	NNSB696	Thailand, Chiang Rai, Thoeng	4.632 ± 0.014	4.638 ± 0.013	4.678 ± 0.014		
	NNSB526–1	Thailand, Kamphaeng Phet, Khlong Lan	4.916 ± 0.021	4.848 ± 0.020	4.907 ± 0.018		
	NNSB697	Thailand, Kamphaeng Phet, Kosamphi Nakhon	4.795 ± 0.016	4.828 ± 0.014	4.843 ± 0.020		
	NNSB827	Thailand, Lamphun, Li	4.987 ± 0.012	4.960 ± 0.021	4.958 ± 0.015		
	NNSB595	Thailand, Tak, Mae Sot	4.881 ± 0.010	4.666 ± 0.015	4.719 ± 0.022	4.670 ± 0.024	4.773 ± 0.024
	NNSB754	Thailand, Tak, Sam Ngao	5.117 ± 0.025	5.120 ± 0.022	5.064 ± 0.018		
	NNSB598	Thailand, Uthai Thani, Ban Rai	5.024 ± 0.009	5.002 ± 0.015			
	NNSB526–2	Thailand, Kamphaeng Phet, Khlong Lan	8.332 ± 0.012	8.328 ± 0.014	8.362 ± 0.021	8.315 ± 0.019	8.320 ± 0.020
NNSB690	Thailand, Phrae, Long	8.023 ± 0.011	7.971 ± 0.013	7.883 ± 0.015			
NNSB524	Thailand, Phrae, Song	8.146 ± 0.015	8.107 ± 0.024	8.015 ± 0.025	8.221 ± 0.021	8.278 ± 0.026	

Species	Accession numbers	Locality	Mean genome size (pg) ± S.D.				
			Plant 1	Plant 2	Plant 3	Plant 4	Plant 5
<i>Kaempferia takensis</i> (continued)	NNSB692	Thailand, Phrae, Song	8.319 ± 0.024	8.318 ± 0.019	8.387 ± 0.022		
<i>K. udonensis</i> Pichens. & Phokham	NNSB508	Thailand, Kanchanaburi, Sai Yok	4.401 ± 0.010	4.338 ± 0.012	4.333 ± 0.018	4.357 ± 0.020	
	NNSB633	Thailand, Kanchanaburi, Sai Yok	4.367 ± 0.013	4.348 ± 0.010	4.374 ± 0.012		
	NNSB736	Thailand, Kanchanaburi, Sai Yok	4.240 ± 0.011	4.249 ± 0.009	4.260 ± 0.014		
	NNSB707	Thailand, Kanchanaburi, Si Sawat	4.332 ± 0.026	4.333 ± 0.015	4.415 ± 0.014		
	NNSB747	Thailand, Kanchanaburi, Si Sawat	4.126 ± 0.012	4.057 ± 0.016			
	NNSB753	Thailand, Kanchanaburi, Si Sawat	4.277 ± 0.022	4.318 ± 0.020	4.327 ± 0.018		
	NNSB687	Thailand, Loei, Pha Khao	4.788 ± 0.018	4.787 ± 0.015	4.844 ± 0.018	4.760 ± 0.011	4.759 ± 0.012
	NNSB599	Thailand, Udon Thani, Nong Wua So	4.636 ± 0.021	4.573 ± 0.016	4.603 ± 0.020	4.744 ± 0.013	
NNSB752	Thailand, Uthai Thani, Ban Rai	4.433 ± 0.019	4.489 ± 0.011	4.558 ± 0.024			

**Appendix S3.** Statistical data of genome sizes based on 276 analysed plants from 15 *Kaempferia* species: normality test and pairwise comparison using Kolmogorov-Smirnov test and Kruskal-Wallis one-way analysis of variance at a significance level of  $p < 0.05$ . All statistical analyses were performed using IBM SPSS Statistics version 21.0.

Table S3. Normality test on genome sizes of analysed species using Kolmogorov-Smirnov test at a significance level of  $p < 0.05$ . Five species, namely *Kaempferia caespitosa*, *K. udonensis*, *K. takensis* (4x), *K. sipraiana* and *K. grandifolia*, were normal distribution, while other analysed species were not normal distribution. – mean = mean genome size; d.f. = degrees of freedom (refers to number of individual plants); Sig. = significance level.

No.	Species	Kolmogorov-Smirnov test ( $p < 0.05$ )			
		mean	d.f.	Sig.	
1	<i>K. simaoensis</i>	3.852	14	.200	
2	<i>K. rotunda</i> (2x)	4.193	19	.200	
3	<i>K. rotunda</i> (3x)	6.983	6	.050	
4	<i>K. rotunda</i> (4x)	8.543	16	.200	
5	<i>K. caespitosa</i>	4.286	3	.000	normal distribution
6	<i>K. udonensis</i>	4.448	30	.027	normal distribution
7	<i>K. subglobosa</i>	4.655	15	.200	
8	<i>K. noctiflora</i> var. <i>noctiflora</i>	4.703	22	.200	
9	<i>K. noctiflora</i> var. <i>thepthepae</i>	4.761	8	.200	
10	<i>K. takensis</i> (2x)	4.854	28	.200	
11	<i>K. takensis</i> (4x)	8.208	16	.010	normal distribution
12	<i>K. sipraiana</i>	4.956	3	.000	normal distribution
13	<i>K. lopburiensis</i>	5.147	19	.065	
14	<i>K. aurora</i>	5.314	11	.200	
15	<i>K. jenttikuliae</i>	5.364	10	.200	
16	<i>K. grandifolia</i>	5.677	9	.042	normal distribution
17	<i>K. graminifolia</i>	5.972	20	.069	
18	<i>K. albiflora</i>	6.045	22	.200	
19	<i>K. calcicola</i>	6.255	5	.200	

Table S4. Pairwise comparison on means of genome sizes of diploid species of *Kaempferia* using Kruskal-Wallis one-way ANOVA at a significance level of  $p < 0.05$ . Statistically significant differences of means between species were highlighted at  $p < 0.05$ .

No.	Species	Significance level ( $p < 0.05$ )															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	<i>K. simaoensis</i>	-	0.485	0.555	0.045	0.014	0.002	0.006	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	<i>K. rotunda</i>	-	-	0.835	0.170	0.054	0.009	0.021	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	<i>K. caespitosa</i>	-	-	-	0.652	0.396	0.026	0.021	0.010	0.013	0.002	0.001	0.001	0.000	0.000	0.000	0.000
4	<i>K. udonensis</i>	-	-	-	-	0.405	0.144	0.152	0.060	0.120	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	<i>K. subglobosa</i>	-	-	-	-	-	0.662	0.483	0.154	0.269	0.010	0.009	0.007	0.001	0.000	0.000	0.000
6	<i>K. noctiflora</i> var. <i>noctiflora</i>	-	-	-	-	-	-	0.697	0.276	0.369	0.047	0.015	0.012	0.002	0.000	0.000	0.000
7	<i>K. noctiflora</i> var. <i>thepthepae</i>	-	-	-	-	-	-	-	0.709	0.562	0.163	0.112	0.094	0.032	0.002	0.001	0.000
8	<i>K. takensis</i>	-	-	-	-	-	-	-	-	0.689	0.141	0.099	0.080	0.020	0.000	0.000	0.000
9	<i>K. sipraiana</i>	-	-	-	-	-	-	-	-	-	0.542	0.332	0.132	0.033	0.013	0.011	0.010
10	<i>K. lopburiensis</i>	-	-	-	-	-	-	-	-	-	-	0.692	0.598	0.264	0.041	0.022	0.009
11	<i>K. aurora</i>	-	-	-	-	-	-	-	-	-	-	-	0.898	0.501	0.048	0.018	0.012
12	<i>K. jenttikuliae</i>	-	-	-	-	-	-	-	-	-	-	-	-	0.592	0.047	0.032	0.015
13	<i>K. grandifolia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.479	0.397	0.336
14	<i>K. graminifolia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.869	0.615
15	<i>K. albiflora</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.685
16	<i>K. calcicola</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

## Willdenowia

Open-access online edition [bioone.org/journals/willdenowia](https://bioone.org/journals/willdenowia)

Online ISSN 1868-6397 · Print ISSN 0511-9618 · 2022 Journal Impact Factor 1.900

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

© 2024 The Authors · This open-access article is distributed under the CC BY 4.0 licence