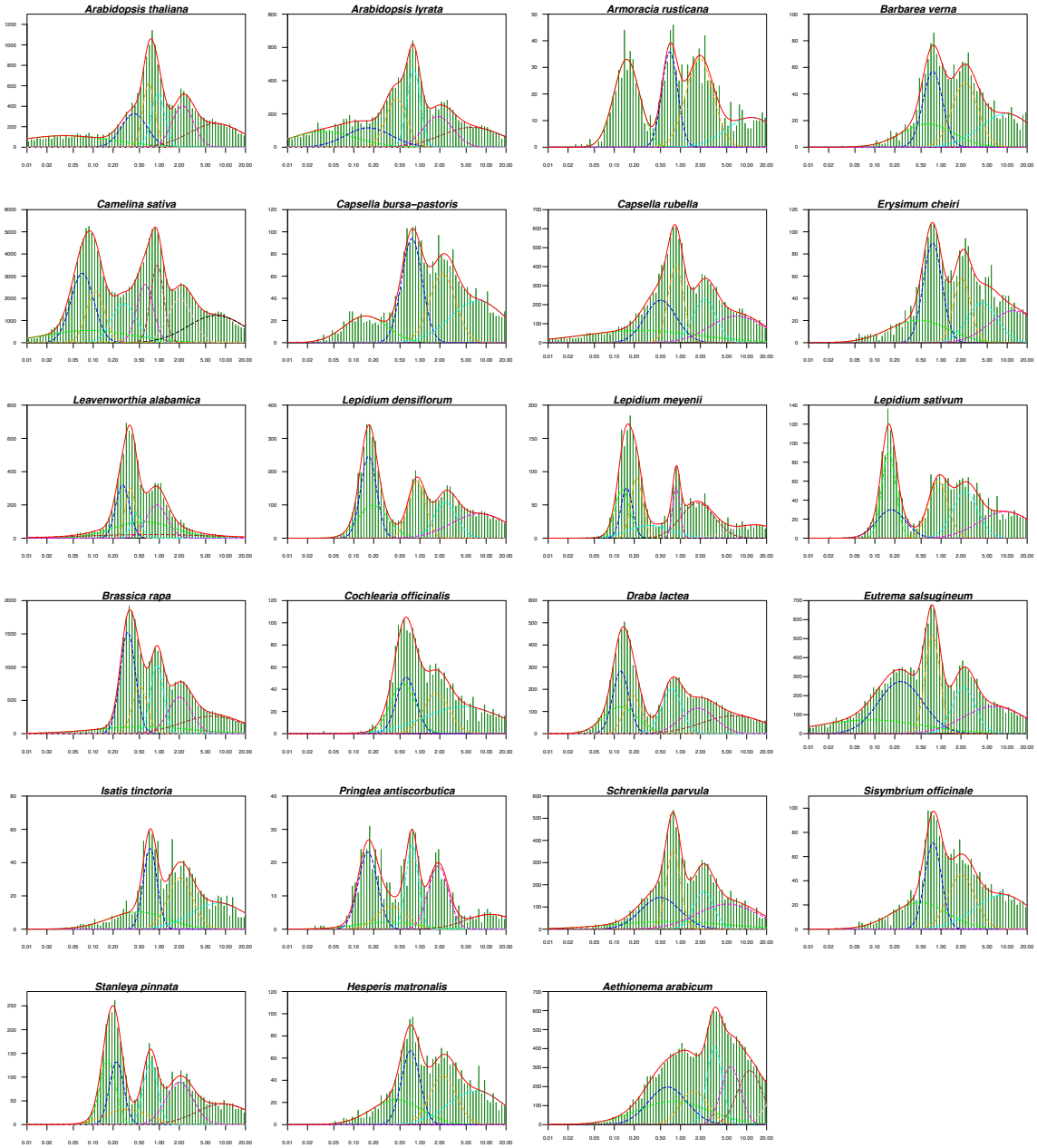
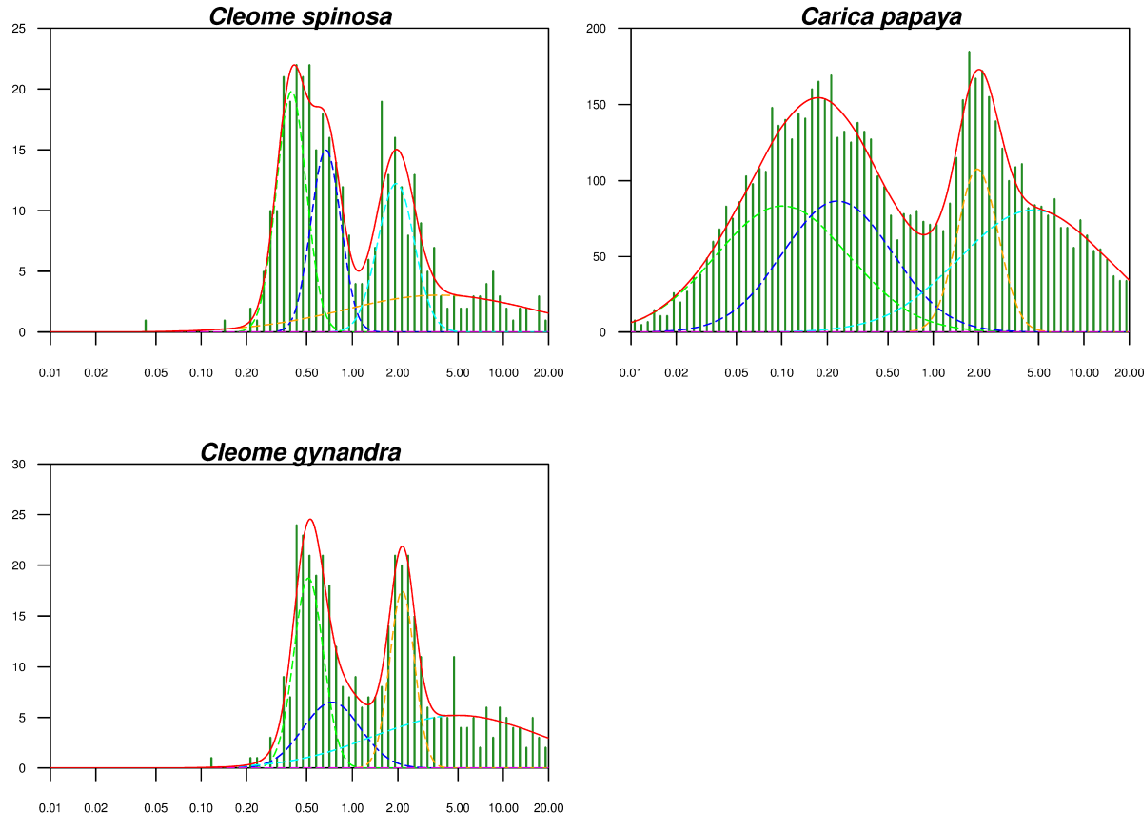
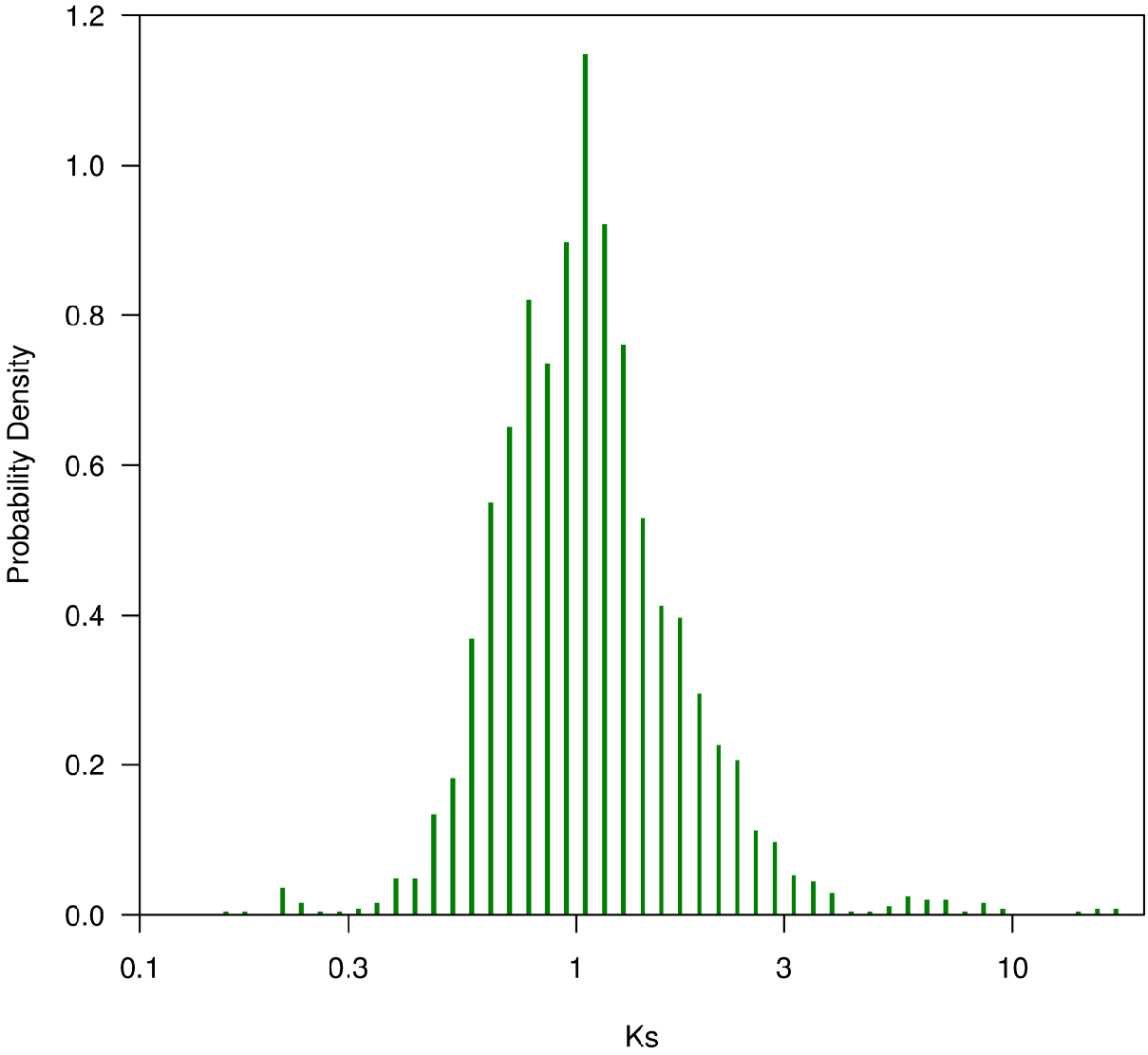


Supplemental Figure 1. Histograms of frequency distributions of Ks values obtained by comparing pairs of paralogous genes of 23 Brassicaceae species.
Values on the X- and Y-axes represent synonymous distance (Ks) and number of duplicates, respectively. The red line in each histogram represents mixture model fitted with normal distribution components. The dotted lines represent the individual Gaussian components. The complete list of mixture model Gaussian components is provided in Supplemental Dataset 1. Major polyploidy events inferred from each distribution and their estimated ages are listed in Supplemental Table 4.

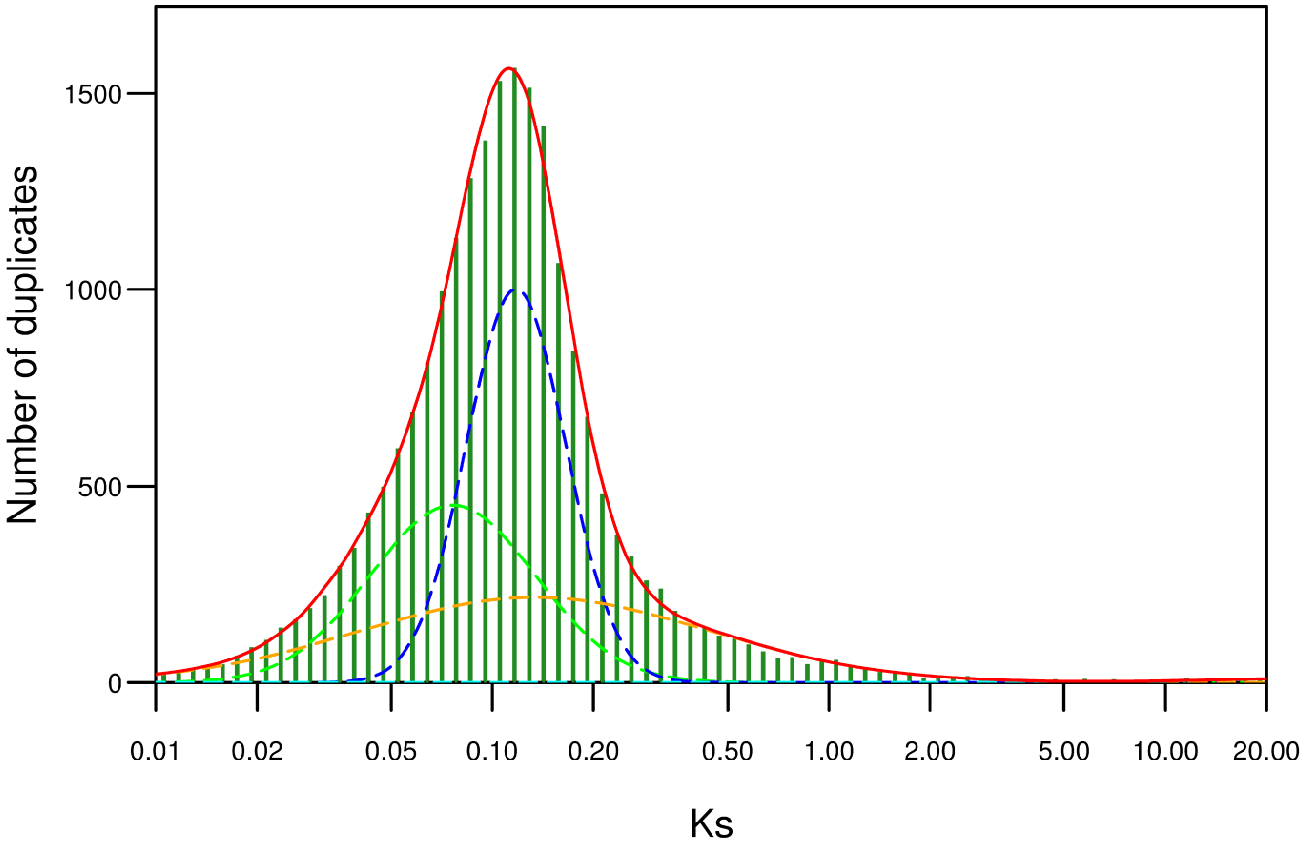


Supplemental Figure 2. Age distributions of duplicated genes in Cleomaceae and Caricaceae species

Histograms of frequency distributions of *Ks* values comparing pairs of paralogous genes of *Cleome* species and *Carica papaya* are shown. Values on the X- and Y-axes represent synonymous distance (*Ks*) and number of duplicates, respectively. The red line in each histogram represents mixture model fitted with normal distribution components and the dotted lines represent the individual Gaussian components.



Supplemental Figure 3. Combined Ks distribution plot of Brassicacaeae vs Cleomaceae species.
Ks distributions of each Brassicaceae species vs. *Cleome spinosa* were compared pairwise by the Kolmogorov Smirnov tests. The array of p-values from each comparison is provided in Supplemental Table 5.



Supplemental Figure 4. Age distribution of homeologous genes in *Brassica napus*.
Histogram of frequency distributions of *Ks* values obtained by comparing pairs of homeologous genes from *B. napus* is shown. The red line in the histogram represents mixture model fitted with normal distribution components. The dotted lines represent the individual Gaussian components.

Supplemental Table 1: Information on the origin, life cycle, and edible and medicinal uses of the Brassicaceae species included in this study.

Information for each species was collected from "Plants for a future" website (http://www.pfaf.org/user/default.aspx)

Scientific name	Common name	Origin/Adaptation[1] (Geographic origin of the seeds used in this study)	Life cycle	Edible parts	Edible uses	Medicinal uses	Other uses
Brassicaceae lineage I							
Armoracia rusticana	Horseradish	Europe (Carmel, Saskatchewan, Canada)	Perennial	Leaves, root, seed	Condiment	Antibacterial, Antirheumatic, Antiseptic, Aperient, Digestive, Diuretic, Expectorant, Rubefacient, Stimulant	Fungicide, Repellent
Barbarea verna	Upland cress	Southwestern Europe (France, Mont-Pincon)	Biennial	Leaves, seed	Oil		
Camelina sativa	False flax, Gold of pleasure	Southeastern Europe and Southwestern Asia	Annual	Oil	Oil		
Capsella bursa-pastoris	Shepherd's Purse	Eastern Europe and Asia minor (Saskatoon, Saskatchewan, Canada)	Annual	Leaves, seed	Condiment, oil	Antiscorbutic, Astringent, Cancer, Diuretic, Emmenagogue, Haemostatic, Homeopathy, Hypotensive, Oxytoxic, Stimulant, Vasoconstrictor, Vasodilator, Vulnerary	Insecticide, Soil reclamation
Erysimum cheiri	Aegean wallflower	Southern Europe	Perennial			Antirheumatic, Antispasmodic, Aphrodisiac, Cardiotonic, Diuretic, Emmenagogue, Expectorant, Nervine, Ophthalmic, Purgative, Resolvent	Essential oil
Lepidium densiflorum	Common pepperweed	North America (Carmel, Saskatchewan,	Annual	Leaves, seed, seedpod		Analgesic, Kidney	

		Canada)					
Lepidium meyenii	Maca	Southern America (Between Junin and Cerro de Pasco, Peru)	Perennial	Leaves, root, seed		Adaptogen, Aphrodisiac, Cancer, Infertility, Nutritive, Tonic.	
Lepidium sativum	Pepper cress	Possibly Iran (Flensburg, Germany)	Annual	Leaves, seed	Condiment, oil	Antiasthmatic, Antiscorbutic, Aperient, Diuretic, Galactogogue, Poultice, Stimulant, Vitamin C	Oil for lighting
Brassicaceae lineage II							
Cochlearia officinalis	Scurvy grass	Coastal and mountainous regions of western, northern and central Europe (Finmark, Norway)	Biennial	Leaves	Salad	Antirheumatic, Antiscorbutic, Aperient, Disinfectant, Diuretic, Stimulant, Vitamin C	Disinfectant
Draba lactea	Lapland whitlow-grass	(Kangiqsujuaq, Quebec, Canada)	Perennial				
Isatis tinctoria	Woad	Central and Southern Europe (Zafferana Etnea, Sicily, Italy)	Biennial	Leaves		Antibacterial, Antiviral, Astringent, Cancer	Dye, Preservative
Pringlea antiscorbutica	Kerguelen cabbage	Antarctic regions	Perennial	Leaves	Condiment	Antiscorbutic	
Stanleya pinnata	Desert's Prince's plume	South-Western North America	Perennial	Leaves, seed		Antipruritic, Odontalgic, Poultice, Tonic, Venereal disease	
Sisymbrium officinale	Hedge mustard	Europe (Madrid, Spain)	Annual	Leaves, seed	Condiment	Antiaphonic, Diuretic, Expectorant, Laxative, Stomachic	Soil conditioner
Brassicaceae lineage III							
Hesperis matronalis	Dame's Rocket	Southern Europe to Siberia	Perennial	Leaves, seed	Oil	Diaphoretic, Diuretic	Essential oil

[1]Origin/Adaptation indicates the suggested centre of origin for the species; in parentheses we have indicated where available the geographic region from which the seed used in this study was collected.

Supplemental Table 2: Completely sequenced Brassicaceae genomes included in this study

Species	Genome version	Download link	Chromosome number (2n)	Genome size (Mb)	Reference
Aethionema Arabicum	v1	http://mustang.biol.mcgill.ca:8885	22	249	Haudry et al., 2013
Arabidopsis thaliana	TAIR10	ftp://ftp.arabidopsis.org/home/tair/Sequences/blast_datasets/	10	157	AGI, 2000
Arabidopsis lyrata	v1.0	http://bioinformatics.psb.ugent.be/plaza/download/index	16	230	Hu et al., 2011
Brassica rapa	v1.2	http://brassicadb.org/brad/downloadOverview.php	20	529	Wang et al., 2011
Camelina sativa	v1.0	http://camelinadb.ca/	40	785	Kagale et al, 2014
Capsella rubella	183	ftp://ftp.jgi-psf.org/pub/compgen/phytozome/v9.0/Crubella/	16	216	Slotte et al., 2013
Leavenworthia alabamica	v1	http://mustang.biol.mcgill.ca:8885	22	316	Haudry et al., 2013
Eutrema salsugineum	173	ftp://ftp.jgi-psf.org/pub/compgen/phytozome/v9.0/Thalophila/	14	260	Yang et al., 2013
Schrenkiella parvula	v1.0	http://thellungiella.org/data/	14	140	Dassanayake et al., 2011

Supplemental Table 3: Roche 454 pyrosequencing, read filtering and assembly statistics for crucifer transcriptomes

Species	Total reads	Total data (bp)	Filtered reads	rRNA reads	High quality reads	Clean data (bp)	Number of isogroups	Number of isotigs	Number of unigenes*	Mean length of ESTs (bp)
Datasets generated in this study										
Brassicaceae lineage I										
Armoracia rusticana	318,249	104,158,153	22,731	1,058	294,460	99,442,871	32531	34,207	32531	453
Barbarea verna	509,825	183,003,782	52,262	914	456,649	174,042,917	46149	48,528	46149	545
Camelina sativa	654,329	184,060,228	565,794	8,556	512,219	165,779,738	24,679	41,439	24,679	600
Capsella bursa-pastoris	636,610	220,415,923	109,385	1,527	525,698	196,538,174	29299	43,787	29299	632
Erysimum cheiri	728,351	260,045,141	153,434	192,842	382,075	137,476,277	20776	21,464	20776	691
Lepidium densiflorum	698,260	284,386,448	132,104	162,879	403,277	162,145,782	24433	27,944	24433	749
Lepidium meyenii	317,304	102,937,822	24,252	682	292,370	99,008,125	28872	33,153	28872	505
Lepidium sativum	710,869	299,571,617	198,476	291,563	220,830	91,156,777	14372	16,021	14372	661
Brassicaceae lineage II										
Cochlearia officinalis	459,753	156,072,854	36,870	1,888	420,995	146,823,218	26839	28,798	26839	570
Draba lactea	657,265	268,755,563	69,411	26,470	561,384	236,452,279	33575	53,470	33575	712
Isatis tinctoria	405,425	129,872,098	29,526	1,180	374,719	123,431,242	30803	32,534	30803	510
Pringlea antiscorbutica	582,473	151,334,384	151,097	22,826	408,550	130,506,889	27788	50,539	27788	384
Sisymbrium officinale	499,983	198,655,081	48,334	1,785	449,864	183,634,013	38819	41,307	38819	603
Stanleya pinnata	695,764	264,587,372	87,488	74,359	533,917	205,625,358	32009	43,785	32009	564
Brassicaceae lineage III										
Hesperis matronalis	735,348	307,895,442	181,784	275,439	278,125	114,214,311	16251	17,230	16251	737
Datasets downloaded from NCBI short read archive										
Cleome spinosa	313,805	70,564,588	67,509	781	245,515	58,658,138	19,328	19,406	19,328	343
Cleome gynandra	402,668	91,851,141	76,809	277	325,582	78,432,152	20,543	20,705	20,543	369

*Non-redundant ESTs

Supplemental Table 4: Estimated ages of the inferred major WGD events in Brassicaceae species

Species	Mode and mean Ks of mixture model components							Estimated maximum age (Mya)**		
	Recent WGD		α WGD		β WGD		γ WGD*	Recent WGD	α WGD	β WGD
	Mode	Mean	Mode	Mean	Mode	Mean	Mean			
Brassicaceae lineage I										
Arabidopsis thaliana	--	--	0.75	0.8	2.30	2.26	7.16	--	48.66	137.2
Arabidopsis lyrata	--	--	0.78	0.8	2.06	1.88	6.05	--	48.83	114.47
Armoracia rusticana	0.15	0.15	0.71	0.69	1.97	1.93	11.86	9.36	41.88	117.62
Barbarea verna	--	--	0.76	0.75	2.30	2.3	9.65	--	45.7	140.12
Camelina sativa	--	0.11	--	0.82	--	2.04	7.21	5.41	45.93	124.46
Capsella bursa-pastoris	--	0.15	0.78	0.76	2.32	2.2	7.51	9.12	46	133.55
Capsella rubella	--	--	--	0.64	--	2.31	7.12	--	39.10	140.51
Erysimum cheiri	--	--	0.74	0.75	2.18	2.07	4.17	--	45.44	125.8
Leavenworthia alabamica	--	0.33	--	0.91	--	--	--	20.07	55.35	--
Lepidium densiflorum	0.17	0.18	0.91	0.9	2.56	2.42	7.94	10.9	54.5	147.09
Lepidium meyenii	0.16	0.16	0.87	0.86	1.79	1.82	13.71	10.03	52.51	110.59
Lepidium sativum	0.16	0.17	0.96	0.9	2.37	2.32	9.43	10.21	54.72	141.2
Brassicaceae lineage II										
Brassica rapa	0.36	0.38	0.92	0.92	2.07	2.03	6.24	23.13	56	123.22
Cochlearia officinalis	--	--	0.61	0.62	1.72	1.77	4.53	--	37.88	107.77
Draba lactea	0.13	0.14	0.79	0.74		1.83	6.43	8.43	44.97	111.48
Isatis tinctoria	--	--	0.73	0.73	2.01	2.06	7.82	--	44.13	125.1
Pringlea antiscorbutica	0.17	0.17	0.75	0.76	1.90	1.93	11.2	10.22	46.07	117.39
Sisymbrium officinale	--	--	0.77	0.76	2.04	2.03	8.5	--	46.12	123.67
Stanleya pinnata	0.19	0.19	0.73	0.73	2.09	2.01	9.19	11.65	44.48	122.53
Eutrema salsugineum	--	--	--	0.74	--	2.20	6.32	--	45.02	133.82
Schrenkiella parvula	--	--	--	0.77	--	2.23	5.11	--	46.83	135.64

Brassicaceae lineage III										
Hesperis matronalis	--	--	0.72	0.72	2.33	2.23	7.02	--	44.07	135.54
BasalGroup										
Aethionema arabicum	--	--	--	0.77	--	2.39	5.75	--	46.83	145.37
Cleomaceae										
Cleome spinosa	0.41	0.4		0.67	1.95	1.95	3.77	24.05	40.75	118.56
Caricaceae										
Carica papaya	0.17	0.15		--	2.01	1.96	4.58	--	--	119.41

*Peak associated with γ WGD was not visible and hence no mode values were calculated
**Calculated based on mixture model mean ln(Ks) values

Supplemental Table 5: Significance of pairwise comparison of orthologous *Ks* distributions between *Cleome spinosa* and diverse Brassicaceae species

Orthologous *Ks* distributions of each Brassicaceae species vs. *Cleome spinosa* were compared in pairwise manner by the Kolmogorov Smirnov tests. The array of p-values from each comparison is provided.

	A. thaliana	*P. antiscorbutica*	*C. bursa-pastoris*	*D. lactea*	*I. tinctoria*	*C. officinalis*	*A. rusticana*	*L. meyenii*	*L. densiflorum*	*H. matronalis*	*S. pinnata*	*L. sativum*	*S. officinale*	*B. verna*
A. thaliana														
P. antiscorbutica	0.0898													
C. bursa-pastoris	0.8107	0.0518												
D. lactea	0.3529	0.0268	0.9680											
I. tinctoria	0.2364	0.6988	0.2962	0.1646										
C. officinalis	0.0015	2.41E-06	0.0011	0.0084	6.31E-06									
A. rusticana	0.2596	0.5135	0.2596	0.2387	0.7623	1.66E-05								
L. meyenii	0.4543	0.0446	0.8395	0.5807	0.0537	0.02530	0.1493							
L. densiflorum	0.3231	0.0047	0.4010	0.6193	0.0083	0.10800	0.0624	0.7760						
H. matronalis	0.2993	0.3390	0.3483	0.2251	0.7673	1.33E-05	0.7119	0.1509	0.0201					
S. pinnata	0.3232	0.7882	0.3004	0.1648	0.9361	1.92E-05	0.7341	0.09019	0.0081	0.9116				
L. sativum	0.3967	0.0232	0.4328	0.8848	0.0278	0.06504	0.06905	0.9649	0.9873	0.0471	0.0657			
S. officinale	0.8896	0.1390	0.9609	0.6866	0.4798	0.001887	0.7982	0.6210	0.1490	0.5412	0.4874	0.3232		
B. verna	0.5173	0.0830	0.6872	0.3391	0.4295	6.45E-05	0.6912	0.3226	0.0765	0.9617	0.5233	0.1733	0.867	
E. cheiri	0.7690	0.2566	0.7023	0.2060	0.2350	0.001178	0.4350	0.4404	0.2694	0.2205	0.4320	0.3160	0.811	0.4281