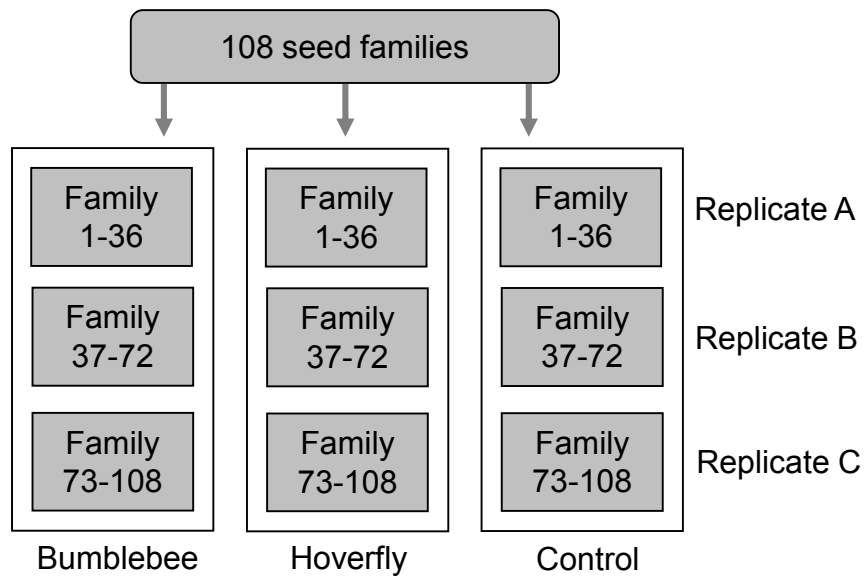


Supplementary Information

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Real time divergent evolution in plants driven by pollinators



Supplementary Figure 1 Design of our evolution experiment at generation one. 108 full sib seed families of fast cycling *B. rapa* plants were split into three treatment groups and three replicates therein. Each replicate consisted of 36 plants. Families were replicated across treatments, to control for genotype among treatment groups.

Supplementary Table 1 Linear (β) and quadratic (γ) selection gradients and differentials (S) (\pm standard err) on all measured traits in the different treatment groups. Significant selection coefficients ($P<0.05$) are given in bold. Asterisks indicate significantly different linear selection gradients between bumblebee- and hoverfly- plants (GLM $P<0.05$).

Trait	Bumblebee			Hoverfly			Control		
	β	γ	S	β	γ	S	β	γ	S
Plant height	0.353\pm0.077*	0.006 \pm 0.050	0.562\pm0.064	0.070 \pm 0.075	-0.133 \pm 0.056	0.198\pm0.064	0.029 \pm 0.086	-0.041 \pm 0.064	0.094 \pm 0.077
No. open flowers	0.390\pm0.067	-0.127 \pm 0.048	0.503\pm0.057	0.209\pm0.067	-0.206\pm0.049	0.268\pm0.058	0.147\pm0.076	-0.286\pm0.068	0.161\pm0.072
Pistil length	-0.072 \pm 0.072	-0.040 \pm 0.057	0.083 \pm 0.064	-0.006 \pm 0.067	-0.020 \pm 0.051	0.034 \pm 0.064	0.001 \pm 0.081	-0.034 \pm 0.059	0.053 \pm 0.076
Petal length	0.260\pm0.103	-0.161 \pm 0.062	0.215\pm0.064	0.063 \pm 0.102	-0.178 \pm 0.065	0.173\pm0.065	0.172 \pm 0.108	-0.135 \pm 0.068	0.164\pm0.075
Petal width	0.159 \pm 0.085*	-0.066 \pm 0.060	0.325\pm0.065	-0.100 \pm 0.075	-0.080 \pm 0.053	0.037 \pm 0.064	-0.038 \pm 0.092	-0.092 \pm 0.069	0.068 \pm 0.076
Flower diameter	-0.116 \pm 0.107	0.181 \pm 0.050	0.159\pm0.065	0.144 \pm 0.104	0.226 \pm 0.065	0.208\pm0.067	-0.008 \pm 0.106	0.051 \pm 0.062	0.116 \pm 0.078
Nectar per flower	0.013 \pm 0.070	0.002 \pm 0.038	0.120 \pm 0.069	0.094 \pm 0.072	-0.024 \pm 0.035	0.125 \pm 0.070	0.090 \pm 0.083	-0.007 \pm 0.052	0.097 \pm 0.081
β -Pinene	0.142 \pm 0.075	-0.098 \pm 0.055	0.070 \pm 0.069	-0.075 \pm 0.088	0.097 \pm 0.048	-0.115 \pm 0.077	0.034 \pm 0.092	-0.117 \pm 0.063	0.044 \pm 0.084
(<i>E,E</i>)- α -Farnesene	-0.028 \pm 0.087	0.000 \pm 0.049	0.066 \pm 0.072	0.113 \pm 0.092	0.137 \pm 0.060	0.031 \pm 0.075	0.277\pm0.105	-0.048 \pm 0.070	0.264\pm0.091
Benzaldehyde	-0.211\pm0.089	-0.177 \pm 0.062	-0.027 \pm 0.070	-0.102 \pm 0.98	-0.255 \pm 0.070	-0.121 \pm 0.074	-0.064 \pm 0.102	-0.068 \pm 0.062	0.011 \pm 0.085
Phenylacetaldehyde	0.233 \pm 0.124	0.248 \pm 0.070	0.100 \pm 0.068	-0.071 \pm 0.121	0.247 \pm 0.081	-0.074 \pm 0.076	0.003 \pm 0.150	0.072 \pm 0.090	0.073 \pm 0.083
Phenylethyl alcohol	-0.140 \pm 0.112	-0.017 \pm 0.048	0.005 \pm 0.070	-0.027 \pm 0.112	-0.042 \pm 0.073	-0.087 \pm 0.076	0.018 \pm 0.132	-0.082 \pm 0.062	0.082 \pm 0.084
Methyl benzoate	0.322\pm0.105*	-0.312\pm0.079	0.257\pm0.071	-0.071 \pm 0.112	0.096 \pm 0.078	-0.065 \pm 0.075	0.085 \pm 0.109	-0.044 \pm 0.062	0.072 \pm 0.085
Methyl salicylate	-0.028 \pm 0.095	0.195 \pm 0.076	0.085 \pm 0.071	0.072 \pm 0.091	-0.117 \pm 0.070	0.004 \pm 0.075	-0.064 \pm 0.102	0.234 \pm 0.064	-0.006 \pm 0.085
p-Anisaldehyde	0.211\pm0.088*	0.108 \pm 0.061	0.166\pm0.069	-0.069 \pm 0.090	0.161 \pm 0.060	-0.033 \pm 0.075	-0.057 \pm 0.103	-0.029 \pm 0.074	0.000 \pm 0.085

Trait	Bumblebee			Hoverfly			Control		
	β	γ	S	β	γ	S	β	γ	S
Benzyl nitrile	-0.392±0.145*	0.025±0.081	0.035±0.070	0.108±0.115	0.134±0.061	-0.001±0.075	-0.066±0.167	0.247±0.091	0.078±0.085
2-Amino benzaldehyde	0.105±0.117	0.046±0.075	0.063±0.072	0.027±0.111	0.153±0.071	0.089±0.077	0.178±0.151	-0.088±0.095	0.120±0.089
Indole	0.297±0.135	-0.217±0.090	0.174±0.072	0.106±0.119	-0.481±0.090	0.034±0.075	-0.059±0.144	-0.157±0.088	0.098±0.087
Methyl anthranilate	-0.071±0.126	-0.197±0.082	0.182±0.076	-0.174±0.123	-0.292±0.087	-0.036±0.074	-0.014±0.127	0.043±0.076	0.083±0.086
Z-(3)-Hexenyl acetate	-0.024±0.080	-0.109±0.065	-0.034±0.070	-0.156±0.095	-0.005±0.059	-0.192±0.081	-0.022±0.095	-0.210±0.085	0.019±0.084
1-Butene-4- isothiocyanate	-0.116±0.076	0.057±0.056	-0.145±0.072	0.004±0.082	-0.194±0.066	-0.055±0.076	0.077±0.089	-0.059±0.068	0.089±0.083
PC1 color (500- 650nm)	-0.063±0.063	-0.027±0.041	-0.056±0.062	0.061±0.022	0.061±0.044	0.061±0.063	0.097±0.075	-0.029±0.051	0.100±0.075
PC2 color (290- 400nm)	0.067±0.065	0.068±0.052	0.063±0.063	0.014±0.064	0.016±0.049	0.005±0.064	-0.112±0.074	-0.034±0.058	-0.114±0.074
PC3 color (400- 500nm)	-0.064±0.064	-0.164±0.049	-0.065±0.064	0.037±0.061	-0.135±0.046	0.033±0.061	-0.004±0.076	-0.075±0.053	-0.001±0.077
PC4 color (260- 290nm)	0.037±0.061	-0.039±0.044	0.029±0.060	-0.106±0.067	-0.093±0.051	-0.106±0.066	-0.024±0.076	0.016±0.045	-0.030±0.076

Supplementary Table 2 Trait differences (mean \pm s.d.) between plants of the different treatment groups at generation 11 (after interreplicate crossings) and correlations with floral nectar. “Corr.” gives Pearson correlation coefficients of each trait with “nectar per flower”, calculated for plants of all treatments and all generations together (values in bold have $P < 0.05$). Values for traits are in cm for morphological traits and $\text{pg} \cdot \text{l}^{-1} \cdot \text{hr}^{-1} \cdot \text{flower}^{-1}$ for scent variables if not otherwise indicated. Variables with significant differences between treatment groups are given in bold; different superscript letters (A, B, C) indicate significant differences between individual groups. For statistical analysis, a general linear model with “treatment” as fixed and “replicate” as random factor and LSD post hoc test was performed. All scent and nectar variables and were logarithmically transformed before statistical analysis.

Trait	Corr.	Bumblebee	Hoverfly	Control	Source	Df	F	P
Plant height	0.07	33.18\pm7.32^A	25.15\pm5.25^B	30.63\pm4.43^C	Treatment	2,4	15.37	0.013
					Replicate	2,4	10.41	0.026
					T*R	4,318	4.52	0.001
No. open flowers	0.02	9.83 \pm 2.65	10.01 \pm 2.70	9.17 \pm 2.27	Treatment	2,4	0.86	0.489
					Replicate	2,4	3.38	0.138
					T*R	4,317	4.37	0.002
Days to flowering	-0.17	17.68\pm1.14^A	18.65\pm1.02^B	17.67\pm0.82^A	Treatment	2,4	10.92	0.024
					Replicate	2,4,4	3.21	0.138
					T*R	4,428	4.09	0.003
Pistil length	-0.03	0.92 \pm 0.11	0.83 \pm 0.13	0.94 \pm 0.10	Treatment	2,4	6.85	0.051
					Replicate	2,4	3.42	0.136
					T*R	4,125	1.99	0.099
Long stamen length	n.a.	0.72 \pm 0.10	0.65 \pm 0.13	0.75 \pm 0.07	Treatment	2,4	3.09	0.154
					Replicate	2,4	1.62	0.305
					T*R	4,125	4.57	0.002
Short stamen length	n.a.	0.59 \pm 0.08	0.51 \pm 0.11	0.58 \pm 0.09	Treatment	2,4	1.65	0.300
					Replicate	2,4	1.19	0.392
					T*R	4,121	6.317	<0.001
Petal length	0.05	0.56 \pm 0.06	0.54 \pm 0.05	0.57 \pm 0.05	Treatment	2,4	1.95	0.256
					Replicate	2,4	0.14	0.872
					T*R	4,318	4.35	0.002

Trait	Corr.	Bumblebee	Hoverfly	Control	Source	Df	F	P
Petal width	0.04	0.51±0.06	0.46±0.05	0.44±0.05	Treatment	2,4	4.83	0.086
					Replicate	2,4	2.23	0.223
					T*R	4,318	10.16	<0.001
Flower diameter	0.13	1.35±0.11	1.30±0.10	1.34±0.12	Treatment	2,4	2.86	0.169
					Replicate	2,4	0.35	0.721
					T*R	4,318	2.86	0.024
UV reflecting area (%)	n.a.	49.78±6.35^A	42.48±5.05^B	41.64±8.31^B	Treatment	2,4.03	40.97	0.002
					Replicate	2, 4.04	7.23	0.046
					T*R	4,130	0.5	0.739
Nectar per flower (nl)		358.21±388.63	338.28±335.00	255.58±239.72	Treatment	2,4	1.36	0.354
					Replicate	2,4	0.13	0.885
					T*R	4,318	2.18	0.074
β-Pinene	0.03	4.82±4.29	5.09±4.54	4.34±2.39	Treatment	2,4	0.09	0.913
					Replicate	2,4	2.74	0.178
					T*R	4,314	6.25	<0.001
<i>(E,E)</i> -α-Farnesene	0.12	1039.77±541.58^A	919.78±401.59^{AB}	849.31±448.50^B	Treatment	2,4	7.76	0.042
					Replicate	2,4	7.98	0.040
					T*R	4,314	0.54	0.704
Benzaldehyde	0.08	289.06±161.02	381.22±264.43	259.36±147.20	Treatment	2,4	1.93	0.259
					Replicate	2,4	0.11	0.110
					T*R	4,314	3.56	0.007
Phenylacet-aldehyde	0.15	233.40±296.83^A	40.31±54.64^B	46.78±75.94^B	Treatment	2,4	32.05	0.003
					Replicate	2,4	2.87	0.169
					T*R	4,314	2.82	0.025
Phenylethyl alcohol	0.04	7.72±10.42^A	1.70±2.43^B	1.94±2.44^B	Treatment	2,4	27.26	0.005
					Replicate	2,4	0.64	0.573
					T*R	4,314	2.75	0.028
Methyl benzoate	0.23	163.02±152.00	109.51±104.52	84.47±71.03	Treatment	2,4	1.49	0.328
					Replicate	2,4	1.89	0.265
					T*R	4,314	7.33	<0.001
Methyl salicylate	-0.01	35.58±36.75^A	14.91±13.17^B	52.18±52.72^C	Treatment	2,4	17.67	0.010
					Replicate	2,4	10.12	0.027
					T*R	4,314	1.41	0.231

Trait	Corr.	Bumblebee	Hoverfly	Control	Source	Df	F	P
p-Anisaldehyde	-0.02	15.20±23.53 ^A	1.52±2.29 ^B	6.20±9.76 ^C	Treatment	2,4	15.31	0.013
					Replicate	2,4	1.09	0.419
					T*R	4,314	4.43	0.002
Benzyl nitrile	0.15	130.63±80.66 ^A	56.56±49.25 ^B	46.92±54.97 ^C	Treatment	2,4	16.02	0.012
					Replicate	2,4	0.26	0.783
					T*R	4,314	3.92	0.004
2-Amino. benzaldehyde	0.14	1194.17±876.50	361.62±377.91	557.79±645.36	Treatment	2,4	4.70	0.089
					Replicate	2,4	0.73	0.536
					T*R	4,314	8.34	<0.001
Indole	0.11	264.81±206.39 ^A	92.56±91.93 ^B	123.63±134.78 ^C	Treatment	2,4	12.05	0.020
					Replicate	2,4	0.49	0.643
					T*R	4,314	4.22	0.002
Methyl anthranilate	0.06	585.48±459.99 ^A	209.24±186.68 ^B	251.88±287.58 ^B	Treatment	2,4	18.82	0.009
					Replicate	2,4	11.05	0.023
					T*R	4,314	0.91	0.456
Z-(3)-Hexenyl acetate	-0.03	73.15±63.60	34.71±43.88	85.95±117.78	Treatment	2,4	1.97	0.254
					Replicate	2,4	0.86	0.490
					T*R	4,314	11.68	<0.001
1-Butene-4- isothiocyanate	0.05	47.47±46.89	57.69±69.42	38.81±39.06	Treatment	2,4	0.16	0.861
					Replicate	2,4	3.82	0.118
					T*R	4,314	7.68	<0.001
Total volatile emission	n.a.	4111.18±2015.09 ^A	2286.43±1044.97 ^B	2409.57±1506.37 ^B	Treatment	2,4	14.44	0.015
					Replicate	2,4	0.29	0.765
					T*R	4,314	3.26	0.012
Seed weight ¹ (mg)	n.a.	1.46±0.47	1.52±0.70	1.52±0.54	Treatment	2,4	0.24	0.799
					Replicate	2,4	11.04	0.023
					T*R	4,97	6.62	<0.001
Germination rate (%) ^{1,2}	n.a.	0.82±0.28	0.92±0.06	0.98±0.03	Treatment	2	0.71	0.527

¹Measured in 9th generation; ²assessed on replicate level; n.a.: not analyzed

Supplementary Table 3 Analysis of color spectrophotometer vales (principle components) for plants of generation 11 using general linear models.

Color variable	source	DF	F	P
Color reflectance PC1 (500-650nm)	Treatment	2,4	1.9	0.262
	Replicate	2,4.6	3.88	0.102
	T*R	4,172	0.59	0.670
Color reflectance PC2 (290-400nm)	Treatment	2,4	0.07	0.932
	Replicate	2,4	0.97	0.483
	T*R	4,172	5.67	<0.001
Color reflectance PC3 (400-500nm)	Treatment	2,4	1.27	0.374
	Replicate	2,4.1	0.23	0.805
	T*R	4,172	3.84	0.005
Color reflectance PC4 (260-290 nm)	Treatment	2,4	1.32	0.363
	Replicate	2,4	3.90	0.114
	T*R	4,172	8.94	<0.001

Supplementary Table 4 Pearson product-moment correlation heatmap using plants of all generations and treatments combined (n=1894 for morphology-morphology, 1654 scent-scent, 1244 morphology-scent, 919 color-scent, 1563 color-morphology; nectar is included in morphology). Nectar and all scent variables were $\ln 1+x$ transformed. Positive correlations are given in shades of red, negative correlation in shades of blue. Correlation coefficients are shown inside the cells. *P<0.05, **P<0.01.

	Plant height	No. of open fl.	Pistil length	Petal length	Petal width	Flower diameter	Nectar	β -Pinene	(E)- α -Farnesene	Benzaldehyde	Phenylacetaldehyde.	Phenylethyl alcohol	Methyl benzoate.	Methyl salicylate	p-Anisaldehyde	Benzyl nitrile	2-Aminobenzaldehyde	Indole	Methyl anthranilate.	(Z)-3-Hexenyl acetate	1-Butene-4-isothiocyanate	Color PC1	Color PC2	Color PC3
No. op. flo.	.354**																							
Pist. length	.232**	.041																						
Pt. length	.105**	.057	.385**																					
Pt. width	.171**	.065**	.193**	.467**																				
Fl. diameter	.176**	.057**	.303**	.739**	.481**																			
Nectar	.074**	.022	-.031	.047	.041	.125**																		
β -Pinene	.032	-.179**	-.095**	-.168**	-.138**	-.049	.027																	
E- α -Farn.	.220**	.011	-.050	-.030	-.008	.031	.115**	.225**																
Benzald.	.026	-.083**	.001	.022	-.020	.069	.078**	.395**	.255**															
Phenylac.	.241**	-.071**	.125**	-.024	.092**	.099**	.146**	.181**	.250**	.213**														
Phenyleth.	.134**	.052	.185**	.104**	.038	.092**	.039	.150**	.249**	.358**	.650**													
Meth.benz.	.264**	-.098**	-.109**	-.056**	-.017	.022	.226**	.214**	.273**	.375**	.309**	.304**												
Meth.sal.	.111**	-.023	.160**	.099**	.056	.055	-.012	.088**	.136**	.154**	.145**	.250**	.474**											
pAnisald.	.190**	.040	.060	.096**	.212**	.123**	-.016	.070**	.122**	.257**	.290**	.327**	.050	.211**										
Benzylnitr.	.151**	-.061**	.067	.033	.098**	.124**	.148**	.204**	.255**	.284**	.676**	.530**	.358**	.234**	.402**									
Aminoben.	.264**	-.085**	.019	.065	.194**	.194**	.141**	.056	.196**	.193**	.370**	.227**	-.072**	.094**	.450**	.506**								
Indole	.310**	-.031	.009	.035	.176**	.134**	.109**	.104**	.311**	.225**	.466**	.365**	.269**	.201**	.389**	.652**	.653**							
Methanth.	.301**	.102**	.062	-.010	.128**	.064	.055	.090**	.262**	.121**	.335**	.337**	.594**	.512**	.268**	.514**	.303**	.575**						
Z3hex.ac.	.168**	-.199**	.035	-.047	-.024	-.015	-.034	.290**	.222**	.255**	.107**	.184**	.157**	.217**	.072**	.109**	.012	.124**	.113**					
But.isoethio.	.057	-.053	-.073	-.161**	-.159**	-.125**	.045	.286**	.225**	.301**	.031	.184**	.254**	.049**	-.027	.101**	-.035	.107**	.139**	.319**				
Color PC1	-.010	-.020	-.013	.101**	.106**	.109**	.052	.037	.065**	.030	.033	.044	.007	.012	.007	.074**	.028	.060	.012	-.034	-.014			
Color PC2	.027	.012	.018	-.010	-.027	-.029	-.026	.000	.001	-.005	.005	-.030	-.016	-.001	.031	-.058	-.065	-.070	-.026	-.003	.069	.000		
Color PC3	.010	.126**	-.051**	.028	-.002	.027	.023	-.068**	.025	-.052	.002	-.007	.005	-.087**	.019	-.033	.000	.018	-.055	-.046	-.014	.000	.000	
Color PC4	.042	.011	.037	.006	.039	-.022	.004	.064	-.039	.014	.020	.020	-.029	-.050	-.005	-.002	.024	-.027	-.048	.040	.034	.000	.000	.000