

Supporting Information

Table S.1 Species and respective family, status and flowering time (Kühn, Durka & Klotz 2004) used in the two datasets to study the heterospecific pollen interference in native and alien plants. Further information about the origin of the used seed or seedling material is provided

Species	Family	Status	Dataset	Naturalized in Germany	Native range	Flowering time	Seed/seedling origin	Type	Pot #	Self-compatibility
<i>Taraxacum officinale</i>	Asteraceae	Native	1	Native	Europe	3-10*	Rieger-Hofmann	Seed	60	self-incompatible
<i>Crepis setosa</i>	Asteraceae	Alien	1	Yes	Southern Europe	6-8	Botanical garden Uni KN	Seed	60	self-compatible
<i>Sinapis alba</i>	Brassicaceae	Alien	1	Yes	Mediterranean	6-10	Rieger-Hofmann	Seed	60	self-incompatible
<i>Knautia arvensis</i>	Caprifoliaceae	Native	1	Native	Europe	5-9	Botanical garden Uni KN	Seed	60	self-compatible
<i>Salvia pratensis</i>	Lamiaceae	Native	1	Native	Europe	5-8	Botanical garden Uni KN	Seed	60	self-compatible
<i>Papaver rhoeas</i>	Papaveraceae	Native	1	Native	Europe	5-9	Botanical garden Uni KN	Seed	60	self-incompatible
<i>Eschscholzia californica</i>	Papaveraceae	Alien	1	Unstable	North America	6-10	Botanical garden Uni KN	Seed	60	self-incompatible
<i>Veronica persica</i>	Plantaginaceae	Alien	1	Yes	Eurasia	2-10	Botanical garden Uni KN	Seed	60	self-compatible
<i>Nigella damascena</i>	Ranunculaceae	Alien	1	Yes	Mediterranean	6-8	Botanical garden Uni KN	Seed	60	self-compatible
<i>Potentilla erecta</i>	Rosaceae	Native	1	Native	Europe	6-9	Rieger-Hofmann	Seed	60	self-incompatible
<i>Solanum nigrum</i>	Solanaceae	Native	1	Native	Europe	6-10	Botanical garden Uni KN	Seed	60	self-compatible
<i>Datura stramonium</i>	Solanaceae	Alien	1	Yes	North America	6-10	Botanical garden Uni KN	Seed	60	self-compatible
<i>Saponaria officinalis</i>	Caryophyllaceae	Native	2	Native	Europe	6-9	Ammann	Seedling	60	self-compatible
<i>Lotus corniculatus</i>	Fabaceae	Native	2	Native	Europe	6-8	Botanical garden Uni KN	Seed	60	self-compatible
<i>Geranium pratense</i>	Geraniaceae	Native	2	Native	Europe	6-8	47.759743, 8.813922	Seedling	60	self-compatible
<i>Geranium pyrenaicum</i>	Geraniaceae	Alien	2	Yes	Southern Europe	5-10	47.759743, 8.813922	Seedling	60	self-compatible
<i>Chelidonium majus</i>	Papaveraceae	Native	2	Native	Europe	4-10	47.759743, 8.813922	Seedling	60	self-compatible

<i>Papaver somniferum</i>	Papaveraceae	Alien	2	Yes	Eastern Mediterranean	6-8	Botanical garden Uni KN	Seed	60	self-incompatible
<i>Linaria vulgaris</i>	Plantaginaceae	Native	2	Native	Europe	6-10	Botanical garden Uni KN	Seed	60	self-incompatible
<i>Nicandra physalodes</i>	Solanaceae	Alien	2	Yes	South America	7-10	Botanical garden Uni KN	Seed	60	self-compatible

*Numbers indicating months

Table S.2 Greenhouse conditions for the two datasets

Dataset	Greenhouse conditions		
	Temperature	Aeratiopn	Light
Dataset 1	Temperature: 15°C at night time, 20°C during day time.	Aeration: opening when Temperature > 24°C.	Additional light: 110 $\mu\text{m}^2\text{s}^{-1}$ light intensity, 6:00–8:30 and 16:00–20:00. (November–March)
Dataset 2	Temperature: 18°C at night time, 20°C during day time.	Aeration: opening when Temperature > 24°C.	Additional light: 110 $\mu\text{m}^2\text{s}^{-1}$ light intensity, 5:00–8:30 and 18:00–21:00. (February–May)

Table S.3 Binomial and Gaussian models including phylogenetic distance and the quadratic phylogenetic distance between pollen donor and recipient species as explanatory variable, for HP interference measured based on fruit set and seed set. Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment.

Phylogenetic distance (PD)	Fruit Set		Seed Set	
Parameter	Estimate (SE)	P (>X ²)	Estimate (SE)	P (>X ²)
<i>Fixed terms</i>				
Intercept	1.663 (0.398)	0.0151	-0.5877 (0.129)	0.0134
PD	-0.0482 (0.184)	0.0624	-0.0575 (0.0820)	0.2037
PD ²	-0.0803 (0.056)	0.1587	0.0012 (0.0261)	0.9639
<i>Random terms</i>	Standard deviation		Standard deviation	
Dataset	0.000		0.000	
Recipient Species	1.443		0.454	
Donor Species	0.497		0.154	
<i>AIC</i>	958.3		948.6	

*SE: standard error. AIC: Akaike information criterion

Table S.4 Binomial and Gaussian models including trait distance and the quadratic trait distance between pollen donor and recipient species as explanatory variable, for HP interference measured based on fruit set and seed set. Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment.

Trait distance (TD)	Fruit Set		Seed Set	
Parameter	Estimate (SE)	P (>X ²)	Estimate (SE)	P (>X ²)
<i>Fixed terms</i>				
Intercept	1.6539 (0.397)	0.0160	-0.5564 (0.134)	0.0172
TD	0.1051 (0.100)	0.5147	0.0300 (0.050)	0.6995
TD ²	-0.0909 (0.068)	0.1834	-0.0284 (0.0346)	0.4180
<i>Random terms</i>	Standard deviation		Standard deviation	
Dataset	0.000		0.000	
Recipient Species	1.438		0.471	
Donor Species	0.486		0.158	
<i>AIC</i>	961.5		949.4	

*SE: standard error. AIC: Akaike information criterion

Table S.5 Linear hypothesis testing and multiple comparisons for the two models with a custom set contrast matrix for both fruit set and seed set. For fruit set, a binomial Generalized Linear Mixed Model (GLMM) was used. For seed set (for the subset of flowers that had produced fruits), a Linear Mixed Model (LMM) was used after log-transforming the response variable. As explanatory variable a dummy factor with six levels was used: (1) conspecific-pollen-only treatment for self-compatible recipient species, (2) heterospecific-pollen treatment for self-compatible recipient and self-compatible donor species, (3) heterospecific-pollen treatment for self-compatible recipient and self-incompatible donor species, (4) conspecific-pollen-only treatment for self-incompatible recipient species, (5) heterospecific-pollen treatment for self-incompatible recipient and self-incompatible donor species, and (6) heterospecific-pollen treatment for self-incompatible recipient and self-compatible donor species. Donor species, recipient species and dataset were included as random factors. SC: self-compatible. SI: self-incompatible.

Linear hypotheses	Fruit Set		Seed Set	
	Estimate (SE)	P (> z)	Estimate (SE)	P (> z)
Fruit or seed set higher for SC than for SI recipients	-0.4796 (0.783)	0.9755	-0.5135 (0.882)	0.9805
Fruit or seed set is higher for CP than for HP treatment	1.3667 (0.259)	<0.001	0.3380 (0.109)	0.0104
HPI higher for SC than for SI recipients	0.5857 (0.289)	0.1903	0.0530 (0.116)	0.9933
Fruit or seed set in HP treatment is higher with same self-compatibility than with opposite self-compatibility donors	0.5719 (0.202)	0.0228	0.0772 (0.095)	0.9223
HPI in HP treatment with opposite self-compatibility donors higher for SC than for SI recipients	0.3608 (0.374)	0.8549	-0.0076 (0.137)	1.0000
HPI in HP treatment with same self-compatibility donors higher for SC than for SI recipients	0.8106 (0.272)	0.0148	0.1136 (0.121)	0.8682

*CP: conspecific pollen treatment. HP: heterospecific pollen treatment, HPI: heterospecific pollen interference. SE: standard error.

Table S.6 Binomial and Gaussian models including phylogenetic distance between pollen donor and recipient species as explanatory variable, for HP interference measured based on fruit set and seed set. Self-compatibility of recipient (self-incompatible or self-compatible) as well as self-compatibility of donor (same self-compatibility or opposite self-compatibility) are included both as factors and as interactions. Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment. P-values were calculated by comparing models with and without the factor in question.

Phylogenetic distance (PD)	Fruit Set		Seed Set	
Parameter	Estimate (SE)	P (>X ²)	Estimate (SE)	P (>X ²)
<i>Fixed terms</i>				
Intercept	0.5449 (0.702)	0.436	-1.0120 (0.265)	0.005
PD	-0.1038 (0.392)	0.134	0.1344 (0.246)	0.151
Self-compatibility recipient (SC)	1.2060 (0.832)	0.152	0.4729 (0.303)	0.151
Self-compatibility donor (opposite)	0.6752 (0.419)	0.011	0.2841 (0.218)	0.088
Self-compatibility recipient×Self-compatibility donor	-0.1622 (0.664)	0.412	-0.1347 (0.274)	0.769
PD×Self-compatibility recipient	0.3091 (0.407)	0.965	-0.2106 (0.254)	0.561
PD×Self-compatibility donor	0.1741 (0.508)	0.338	-0.2007 (0.286)	0.719
PD×Self-compatibility recipient×Self-compatibility donor	-1.0551 (0.746)	0.155	0.1867 (0.306)	0.543
<i>Random terms</i>	Standard deviation		Standard deviation	
Dataset	0.000		1.130*10 ⁻⁸	
Recipient Species	1.362		4.213*10 ⁻¹	
Donor Species	0.478		1.416*10 ⁻¹	
<i>AIC</i>	958.2		953.7	

*SE: standard error. AIC: Akaike information criterion

Table S.7 Binomial and Gaussian models including floral trait (pollen size and style length) distance between pollen donor and recipient species as explanatory variable, for HP interference measured based on fruit set and seed set. Self-compatibility of recipient (self-incompatible or self-compatible) as well as self-compatibility of donor (same self-compatibility or opposite self-compatibility) are included both as factors and as interactions. Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment. P-values were calculated by comparing models with and without the factor in question.

Trait distance (TD)	Fruit Set		Seed Set	
Parameter	Estimate (SE)	P (>X ²)	Estimate (SE)	P (>X ²)
<i>Fixed terms</i>				
Intercept	0.0762 (0.735)	0.917	-1.0845 (0.302)	0.005
TD	-0.5818 (0.429)	0.500	-0.2091 (0.264)	0.733
Self-compatibility recipient (SC)	1.590 (0.865)	0.193	0.5727 (0.338)	0.144
Self-compatibility donor (opposite)	1.2179 (0.476)	0.005	0.3742 (0.260)	0.143
Self-compatibility recipient×Self-compatibility donor	-0.8588 (0.687)	0.662	-0.2468 (0.311)	0.548
TD×Self-compatibility recipient	0.7041 (0.449)	0.811	0.1809 (0.272)	0.675
TD×Self-compatibility donor	0.7919 (0.461)	0.940	0.2819 (0.282)	0.189
TD×Self-compatibility recipient×Self-compatibility donor	-1.0287 (0.521)	0.050	-0.1622 (0.306)	0.598
<i>Random terms</i>	SD		SD	
Dataset	7.850*10 ⁻⁸		0.000	
Recipient Species	1.379		0.437	
Donor Species	4.696*10 ⁻¹		0.142	
<i>AIC</i>	959.5		954.3	

*SE: standard error. AIC: Akaike information criterion

Table S.8 Binomial and Gaussian models including style length difference (recipient species – donor species) as explanatory variable, for HP interference measured based on fruit set and seed set. Recipient status (alien or native) as well as donor status (same-status or opposite-status) are included both as factors and as interactions. Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment. P-values were calculated by comparing models with and without the factor in question.

Style length difference (SD)	Fruit Set		Seed Set	
Parameter	Estimate	P	Estimate	P
<i>Fixed terms</i>	(SE*)	(>X ²)	(SE)	(>X ²)
Intercept	2.3930 (0.659)	0.0096	-0.3879 (0.215)	0.1165
SD	0.2263 (0.270)	0.0524	0.2111 (0.104)	0.2244
Recipient status (native)	-1.3182 (0.946)	0.3441	-0.1649 (0.232)	0.8035
Donor status (opposite)	-1.0365 (0.362)	0.0032	-0.1311 (0.184)	0.6164
Recipient status×Donor status	0.8450 (0.559)	0.1989	0.2109 (0.309)	0.4989
SD×Recipient status	-1.4955 (0.488)	0.0005	-0.2150 (0.208)	0.2088
SD×Donor status	-0.4471 (0.313)	0.3105	-0.1177 (0.124)	0.2834
SD×Recipient status×Donor status	0.6262 (0.573)	0.2713	0.0428 (0.266)	0.8749
<i>Random terms</i>	Standard deviation		Standard deviation	
Dataset	0.000		0.188	
Recipient Species	1.599		0.238	
Donor Species	0.318		0.234	
AIC	783.0		675.1	

*SE: standard error. AIC: Akaike information criterion

Table S.9 Binomial and Gaussian models including pollen size difference (recipient species – donor species) as explanatory variable, for HP interference measured based on fruit set and seed set. Recipient status (alien or native) as well as donor status (same-status or opposite-status) are included both as factors and as interactions. Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment. P-values were calculated by comparing models with and without the factor in question.

Pollen size difference (PS)	Fruit Set		Seed Set	
Parameter	Estimate	P	Estimate	P
<i>Fixed terms</i>	(SE*)	(>X ²)	(SE)	(>X ²)

Intercept	2.6734 (0.609)	0.0049	-0.1522 (0.183)	0.4082
PS	0.5667 (0.480)	0.8650	0.6022 (0.191)	0.1565
Recipient status (native)	-1.3690 (0.857)	0.2692	-0.6543 (0.257)	0.0413
Donor status (opposite)	-1.0191 (0.364)	0.0039	-0.3026 (0.151)	0.1414
Recipient status×Donor status	0.9285 (0.601)	0.1447	0.2780 (0.241)	0.2583
PS×Recipient status	-0.8603 (0.505)	0.0314	-0.6381 (0.202)	0.0110
PS×Donor status	-0.0742 (0.493)	0.4037	-0.3331 (0.191)	0.7193
PS×Recipient status×Donor status	0.3246 (0.579)	0.5774	0.4393 (0.238)	0.0714
<i>Random terms</i>	Standard deviation		Standard deviation	
Dataset	0.000		0.000	
Recipient Species	1.526		0.408	
Donor Species	0.521		0.178	
<i>AIC</i>	952.1		941.9	

*SE: standard error. AIC: Akaike information criterion

Table S.10 Custom set contrast matrix used for the linear hypothesis testing and multiple comparisons for parametric models to test whether HP affected fruit set and seed set, and whether this depended on the status of the pollen recipient and donor species

Recipient	Native			Alien			Linear hypotheses:
Donor	Native	Native	Alien	Alien	Alien	Native	
Pollentype	CP*	HP*	HP	CP	HP	HP	
Contrast Matrix	1/3	1/3	1/3	-1/3	-1/3	-1/3	Fruit or seed set higher for native than for alien recipients
	1/2	-1/4	-1/4	1/2	-1/4	-1/4	Fruit or seed set is higher for CP than for HP treatment
	1/2	-1/4	-1/4	-1/2	1/4	1/4	HPI higher for native than for alien recipients
	0	1/2	-1/2	0	1/2	-1/2	Fruit or seed set in HP treatment is higher with same status than with opposite status donors
	1/2	0	-1/2	-1/2	0	1/2	HPI in HP treatment with opposite status donors higher for native than for alien recipients
	1/2	-1/2	0	-1/2	1/2	0	HPI in HP treatment with same status donors higher for native than for alien recipients

*CP: conspecific pollen treatment. HP: heterospecific pollen treatment, HPI: heterospecific pollen interference.

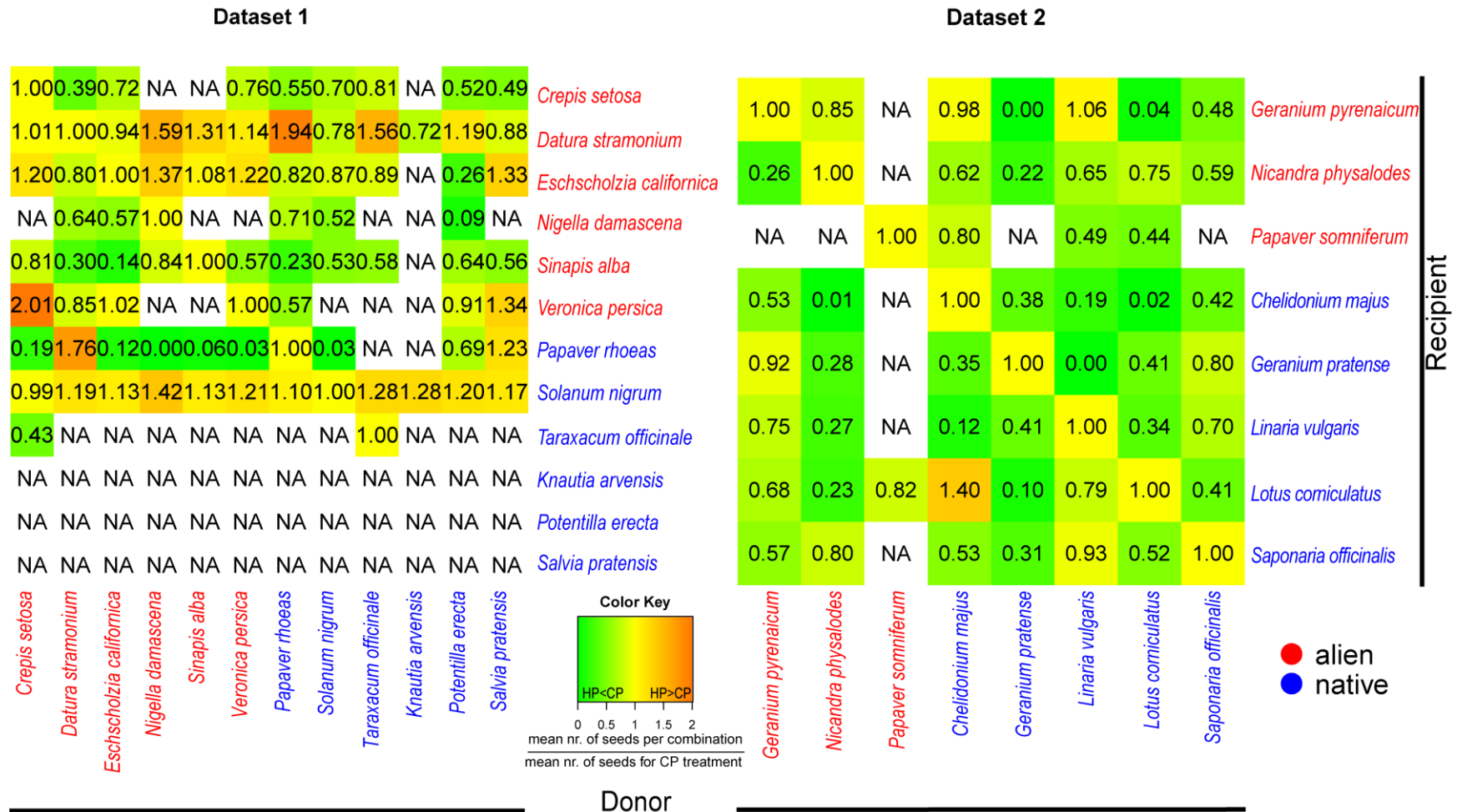


Figure S.1 Pollen Recipient-Donor combinations for the two datasets with the average effect size per combination for number of seeds per fruit. Note that for Dataset 1, *Knautia arvensis*, *Salvia pratensis* and *Potentilla erecta* are present as donors only. . As we initially focused on the novel question whether alien plants suffer from HP interference, we prioritized in the first group those species combinations in which the alien species were pollen recipients. In the second group, we therefore added more of the combinations in which natives are pollen recipients.

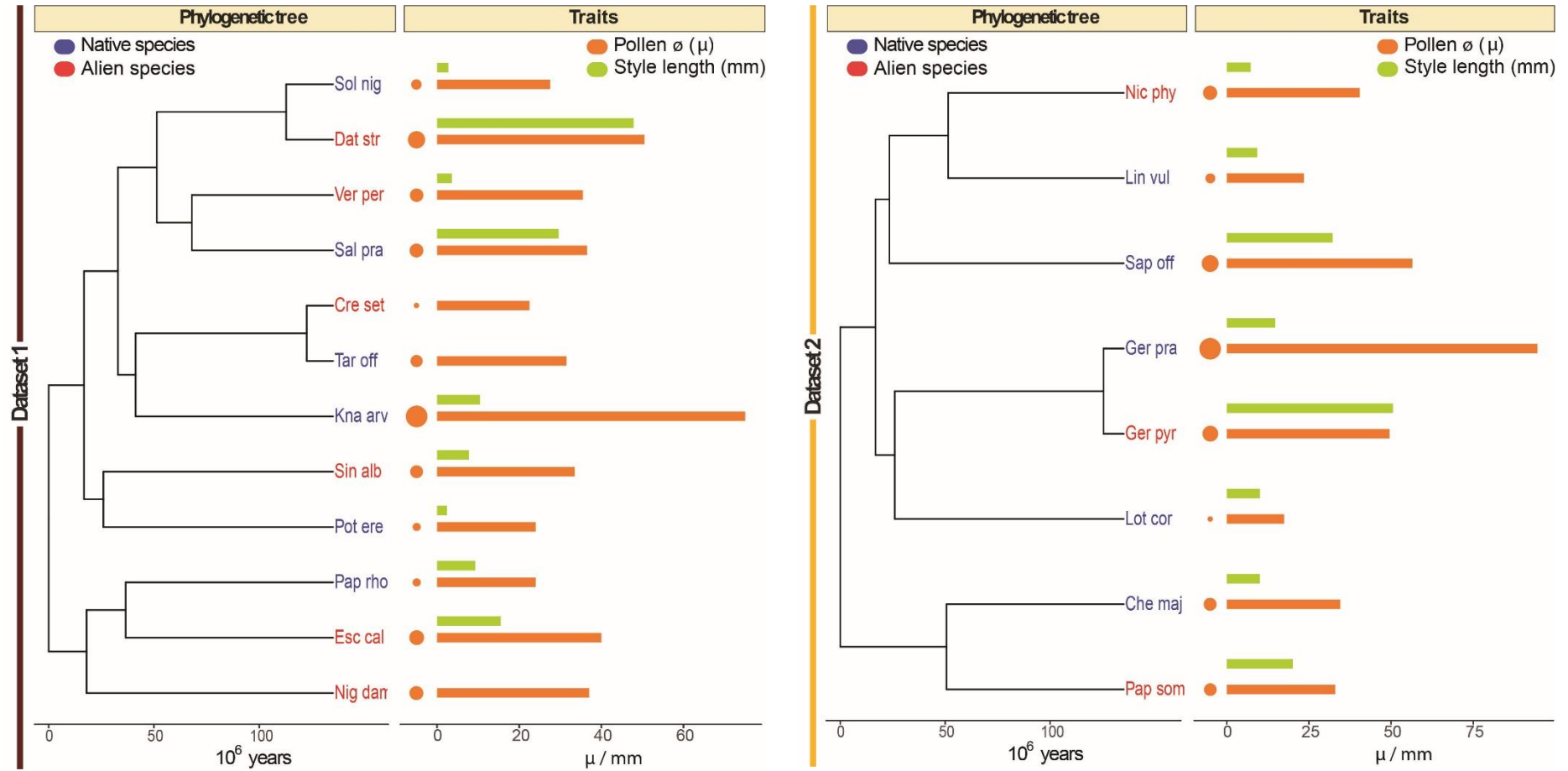


Figure S.2 Phylogenetic tree and traits measured for the species of the two datasets, pollen size (μ) and style length (mm) (means per species). Species names are shortened (see Table S.1 for complete list)

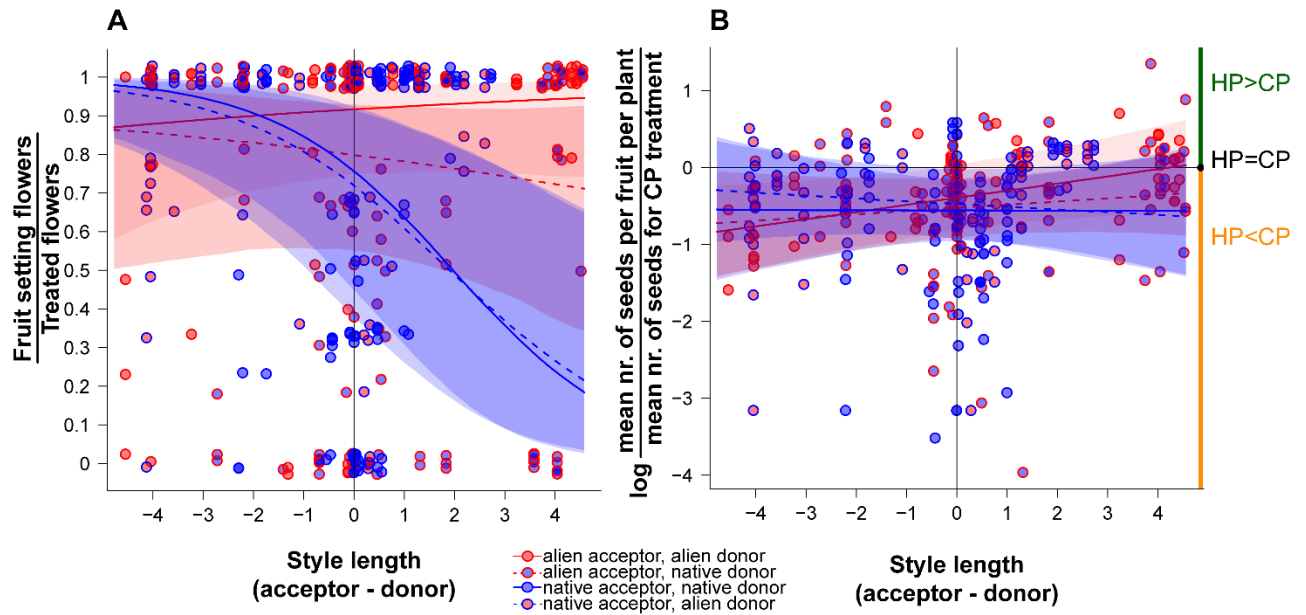


Figure S.3 Data points for each individual plant receiving HP treatment and fitted lines (with 95 % credible intervals) for the binomial and Gaussian models including style length difference (recipient species – donor species) as explanatory variable, for fruit set (A) and seed set (B). Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment. Blue solid line and blue dots: native recipient with native donor. Blue dotted line and blue dots with red background: native recipient with alien donor. Red solid line and red dots: alien recipient with alien donor. Red dotted line and red dots with blue background: alien recipient with native donor. CP: conspecific pollen treatment. HP: heterospecific pollen treatment.

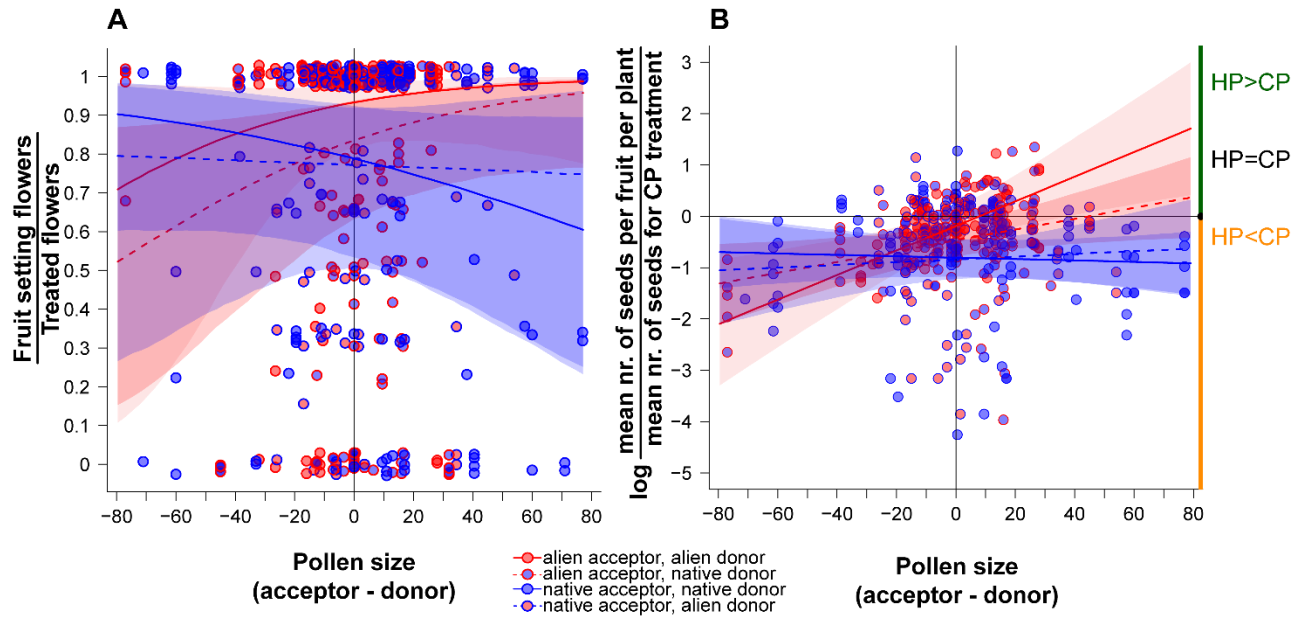


Figure S.4 Data points for each individual plant receiving HP treatment and fitted lines (with 95% credible intervals) for the binomial and Gaussian models including pollen size difference (recipient species – donor species) as explanatory variable, for fruit set (A) and seed set (B). Seed set is expressed as the natural log of the ratio of the mean number of seeds per plant and the mean number of seeds for conspecific pollen treatment. Blue solid line and blue dots: native recipient with native donor. Blue dotted line and blue dots with red background: native recipient with alien donor. Red solid line and red dots: alien recipient with alien donor. Red dotted line and red dots with blue background: alien recipient with blue donor. CP: conspecific pollen treatment. HP: heterospecific pollen treatment.

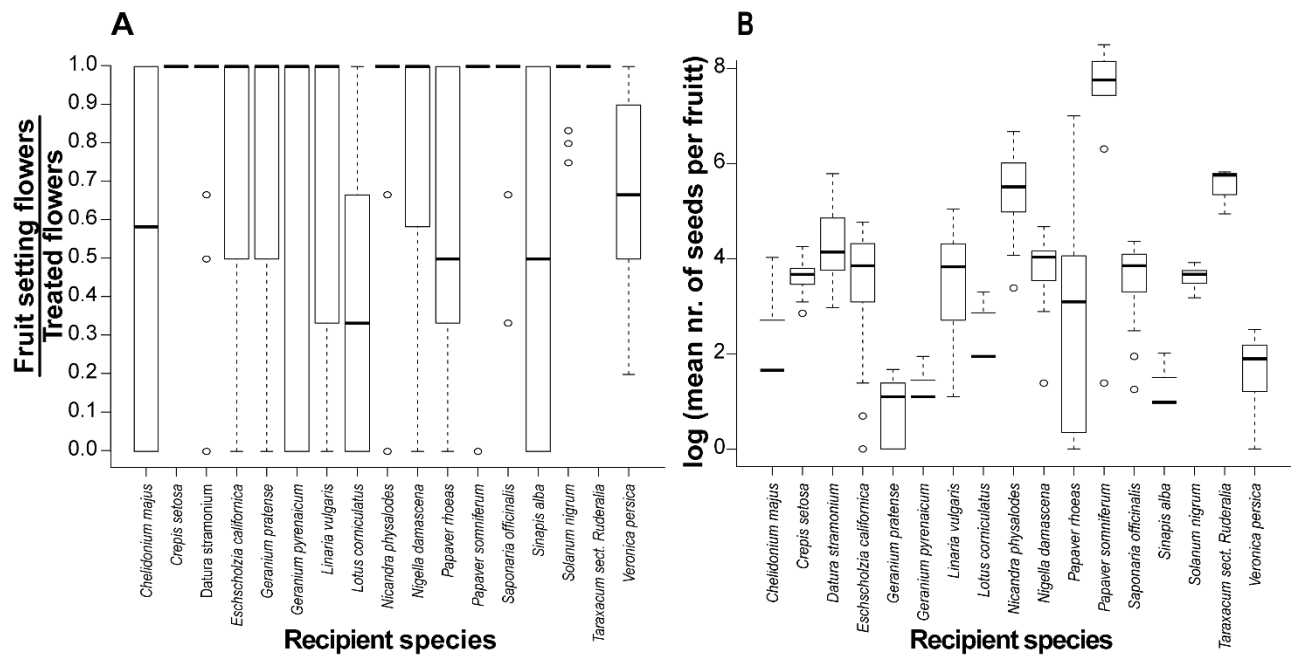


Figure S.5 Boxplot showing the raw data for the different pollination treatments per Recipient species, for fruit set expressed as the proportion of fruit setting flowers on treated flowers (A) and seed set expressed as the natural log of the number of seeds per fruit per plant (B).