Article title: Functional trait divergence and trait plasticity confer polyploid advantage in heterogeneous environments

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Article acceptance date: 24 September 2018

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Common garden soil
Newport beds used a mixture of equal parts beach sand and Bandon fine sandy loam, a low clay content (5–15%) soil derived from the sandy alluvium of coastal marine terraces. Corvallis beds used Chehalis silt clay loam, a richer soil characterized by higher clay content (typically 35–45%). Bend beds used Lundgren ashy sandy loam, a soil characterized by high volcanic ash, glass, and pumice content.

Common garden weather data
We obtained daily data of temperature and rainfall for the three common gardens from different sources: Newport data from the Hatfield Marine Science Center (http://weather.hmsc.oregonstate.edu/weather/weatherproject/archive/), Corvallis and Bend data from AgriMet (https://www.usbr.gov/pn/agrimet/webagdayread.html). We then calculated the monthly mean temperature, monthly rainfall and monthly growing degree days (i.e. the cumulative heat above 10°C) for each garden location, during the course of the field experiment from October 2015 to mid July 2016.

Measurements of leaf functional traits
We collected the largest, fully expanded leaf from each experimental plant in selected beds in each garden. The leaves were scanned using a CanoScan LiDE 220 (Canon, Melville, NY, USA) with an antiglare styrene sheet. We used ImageJ v1.51a (Schneider et al., 2012) to measure leaf area (LA) and the central leaflet width (CLW).

The seven leaf functional traits included: specific leaf area (SLA), which measures the light-capturing leaf area per unit investment of dry mass (Poorter et al., 2009); leaf nitrogen content ($N_{\text{mass}}$), which influences photosynthetic potential (Wright et al., 2004); stomatal length (SL) and stomatal density (SD) that regulate plant CO$_2$ intake and water transpiration (Hetherington & Woodward, 2003); minor vein density (VLA) that reflects hydraulic conductance (Sack & Scoffoni, 2013); trichome density (TD), which can protect plants against water loss (Ehleringer & Björkman, 1978; Sletvold & Ågren, 2012); and carbon isotope
discrimination ($\Delta^{13}C$) that indicates plant intrinsic water use efficiency (Farquhar & Richards, 1984).

We obtained four leaf punches (each of 6 mm in diameter) from the middle portion of the central leaflet of the collected trifoliate leaf each sample, avoiding the midvein. Two leaf punches were used for measuring stomatal density and stomatal length of the abaxial and adaxial sides; one leaf punch was for measuring SLA; and one was for measuring trichome density and then vein density. When the central leaflet was not large enough for all trait measurements, we obtained two leaf punches from the central leaflet for stomatal density and stomatal length measurements, and one leaf punch from each of the two lateral leaflets for SLA, and trichome density and vein density, respectively.

For SLA estimation, one leaf punch per sample was stored in 96-well microplates (Thermo Fisher Scientific, Hampton, NH, USA), and dried at 65°C for 24 h. Leaf punches were then weighed using a Cahn C-35 microbalance (Thermo Fisher Scientific; with precision of 0.0001 mg). SLA was calculated using the known punch area divided by punch weight.

For stomatal measurements, we used a vinyl polysiloxane impression method to obtain the abaxial and adaxial stomata from leaf punches. First, we mixed the vinyl polysiloxane impression material (Patterson Dental, Pittsburgh, PA, USA) of the base and catalyst, and put the mixture onto a microscope slide. Two punches per sample were placed immediately onto the mixture, one for each side of the leaf. We placed another microscope slide on the top, and pressed slightly and held two slides together using binder clips. After the mixture dried (c. 15 min), the top slide and leaf punches were removed from the mixture using forceps to obtain permanent leaf impression. We applied clear nail polish to the impression and peeled off the impression using clear tapes, and placed it onto a new microscope slide for measuring stomatal density and stomatal length. The abaxial and adaxial stomata were counted using a Leica DM500 microscope (Leica Microsystems, Wetzlar, Germany) under 400× (10 × 40) magnification. Specifically, we counted the total number of stomata within two randomly selected fields of view (FOV) for each side. Stomatal density was calculated as the average number of stomata within a FOV divided by the area of the FOV. We took images of the abaxial and adaxial stomata, and measured the guard cell lengths of up to five stomata of each side and
obtained the average stomatal length. As most *Fragaria* plants only produce stomata on the abaxial side, we only reported abaxial stomatal density and stomatal length.

For trichome density estimation, one leaf punch per sample was stored in 70% ethanol. We counted the number of trichomes on both sides of a leaf punch under a dissecting microscope. If there were no more than 50 trichomes on one side, we counted all the trichomes. If there were >50 trichomes on one side, we counted trichomes within two randomly selected areas (each area = 1.5 mm × 1.5 mm) of a leaf punch. We summed the abaxial and adaxial trichome density for calculating TD. Leaf punches were then returned to 70% ethanol for subsequent vein density measurement.

Vein density here is defined as the total lengths of minor veins per unit leaf area. We only focused on minor veins, as they account for >80% of the total veins of a leaf and are key to leaf hydraulic capacity and photosynthesis (Sack & Scoffoni, 2013). We followed the protocol of Quantifying Leaf Vein Traits (http://prometheuswiki.org/tiki-index.php?page=Quantifying+leaf+vein+traits), using leaf punches stored in 70% ethanol. We took leaf vein images using a Leica DM500 microscope under 40× magnification, and used ImageJ to record the total lengths of minor veins within a 1 mm × 1 mm area.

The remaining leaf tissue after four leaf punches being taken was dried at 65°C for 48 h, and sent to the Cornell Isotope Laboratory for carbon isotope composition (δ\(^{13}\)C) and \(N_{\text{mass}}\) analysis using a Thermo Delta V isotope ratio mass spectrometer and a NC2500 elemental analyzer. Carbon isotope discrimination (Δ\(^{13}\)C) was calculated using the following formula (Farquhar & Richards, 1984):

\[
\Delta^{13}C = \frac{\delta^{13}C_{\text{air}} - \delta^{13}C_{\text{plant}}}{1 + \delta^{13}C_{\text{plant}} / 1000}, \%
\]

where \(\delta^{13}C_{\text{air}}\) equals -8‰.

Plastid phylogeny

The chloroplast nucleotide supermatrix (with 64645 characters), composed of the diploid and polyploid *Fragaria* taxa in this study (except *F. chiloensis* ssp. *chiloensis*) and three other diploid *Fragaria* taxa, as well as the outgroup *Dasiphora fruticosa* ssp. *floribunda* (Fig. S4), was kindly provided by M.S. Dillenberger (Oregon State University). We performed phylogenetic inference
using the maximum likelihood (ML) method with the GTR+Γ model in RAxML v.8.0.26 (Stamatakis, 2014). Confidence in node support was determined with 1000 bootstrapping replicates.

**Phylogenetic general linear mixed models (PLMMs)**

PLMMs were performed to validate our use of nested random effects in LMMs (i.e. populations nested in taxa and taxa in ploidy levels, ploidy/taxon/population; see main text) to control for evolutionary dependence among populations and taxa. Here we used the bifurcating, plastid tree (Fig. S4) for fitting PLMMs, due to the difficulty of accounting for reticulate evolutionary histories among diploid and polyploid taxa (Fig. 1) in PLMMs. Owing to the lack of *F. chiloensis* ssp. *chiloensis* in the plastid tree, we assumed that it had the same evolutionary history as *F. chiloensis* ssp. *pacific*. We conducted PLMMs using the R package MCMCglmm (Hadfield, 2010), with one functional trait (stomatal length, Fig. S5) and the composite fitness (Fig. S6) as examples.

To evaluate how diploids and polyploids differ in stomatal length, similar to the LMM fitted using restricted maximum likelihood (REML) with the package lme4 (Bates et al., 2015) (see main text; Fig. S5, Model 1), we first fitted the same LMM using the Bayesian method with MCMCglmm (Fig. S5, Model 2), where the random effects included ploidy/taxon/population. Then for PLMMs, we fitted two models that differed from the LMMs (Model 1 and Model 2) only in random effects: one PLMM model considered only phylogenetic covariance among taxa (random effects = phylo; Fig. S5, Model 4); one PLMM model considered both populations nested in taxa and phylogenetic covariance among taxa (random effects = taxon/population + phylo; Fig. S5, Model 3). We performed the same four types of models for modeling fitness (Fig. S6).

To fit MCMCglmm models, we used default priors for predictors (fixed effects) and uninformative priors (*V* = 1, *nu* = 0.02) for all random effects and residual variance. Models were run with 200000 total MCMC iterations (burn of 100000, and thinning of 100), and convergence was checked graphically. For Bayesian model comparisons based on the deviance
information criterion (DIC), we used the package MuMIn (Bartoń, 2017). Least-squares means of predictors in MCMCglmm models were estimated using the package lsmeans (Lenth, 2016).

For both the functional trait (Fig. S5) and composite fitness (Fig. S6), LMM Model 2 (the Bayesian version of Model 1) with nested random effects outperformed PLMM Model 4 that only considered phylogenetic relatedness among taxa, but performed as well as PLMM Model 3 that considered both populations nested in taxa and phylogenetic relatedness among taxa.
Fig. S1 Distinct separation between diploid and high-order polyploid *Fragaria*, with stomatal length (SL) as an example. The least-squares mean of SL and 1 SEM are plotted. Significant differences are only observed between diploids \((2n = 2x)\) and high-order polyploids \((2n \geq 6x)\). The response variable (SL) was power transformed to improve normality in a general linear mixed model, where the fixed effects included central leaflet width + climatic niche distance + garden + ploidy + ploidy: garden + ploidy: climatic niche distance, and the nested random effects included ploidy/taxon/population. Owing to the distinct separation between diploids and high-order polyploids, and the dominance of the 8x taxa and genotypes (Table S1; also smaller SEM relative to the 6x and 10x here), we defined ploidy level broadly as diploid or polyploid in the main text and all downstream analyses.
Fig. S2 Collection map of *Fragaria* from our Wild Strawberry website (http://wildstrawberry.org/; accessed on April 25, 2018). This worldwide collection of *Fragaria* was conducted as an international collaborative effort from 2013 to 2014. Each dot represents one population, and the collection data of genotypes within each population are available from the Wild Strawberry website. Briefly, achenes (averagely 70 per plant) were collected from 1–28 plants (mean = 15) of individual populations. For this study, we considered *Fragaria* that occur in North America, South America, Europe and Japan.
Fig. S3 Climatic niche distances of 72 source *Fragaria* populations to the common gardens. (a) The first two principal components of PCA of the 19 bioclimatic variables and elevation estimates of the 72 source *Fragaria* populations and the three common gardens (the stars). The variables with the largest loadings are indicated by the arrows. (b) The first five PCs, accounting for 94.2% of the variation, were used to calculate Euclidean climatic niche distance between each source population and each garden.
Fig. S4 Maximum-likelihood (ML) plastid phylogeny of Fragaria. This phylogeny reflects only the evolutionary histories of the plastid genome, but not the reticulate histories of the nuclear genome among diploid \((2n = 2x)\) and polyploid \((2n \geq 6x)\) taxa (Fig. 1) that are difficult to be incorporated into general linear mixed models for controlling for evolutionary dependence among taxa. This phylogeny included the diploid and polyploid Fragaria in this study (black), and those not (grey). Numbers associated with branches are ML bootstrap support values (%) from 1000 replicates.
Fig. S5 Model comparisons for controlling for evolutionary dependence among populations and taxa, with stomatal length (SL) as an example. The response variable (SL) was power transformed to improve normality. LMM Model 2 (the Bayesian version of Model 1) with nested random effects outperformed PLMM Model 4 that only considered phylogenetic covariance among taxa. The least-squares mean and 1 SEM are plotted for diploids (blue) and polyploids (red) at each garden location for each model.

| Model | Fixed effects | Random effects | Model type | Method  | DIC  | ΔDIC |
|-------|---------------|----------------|------------|---------|------|------|
| 1     | CLW + climatic niche distance + ploidy/taxon/population | LMM | REML<sup>a</sup> | -887.9 | 0    |
| 2     | garden + ploidy + ploidy:garden | LMM | Bayesian<sup>b</sup> | -887.8 | 0.15 |
| 3     | + ploidy:climatic niche distance | PLMM | Bayesian<sup>b</sup> | -854.1 | 33.79 |
| 4     | taxon/population + phylo phylo | PLMM | Bayesian<sup>b</sup> | -854.1 | 33.79 |

LMM, general linear mixed model
PLMM, phylogenetic general linear mixed model
REML, restricted maximum likelihood
<sup>a</sup>using lme4 package; <sup>b</sup>using MCMCglmm package
CLW, central leaflet width
Fig. S6 Model comparisons for controlling for evolutionary dependence among populations and taxa, with the composite fitness as an example. The response variable (the composite fitness index) was power transformed (with power parameter = 0.1) to improve normality. LMM Model 2 (the Bayesian version of Model 1) with nested random effects outperformed PLMM Model 4 that only considered phylogenetic covariance among taxa. The least-squares mean and 1 SEM are plotted for diploids (blue) and polyploids (red) at each garden location for each model.

| Model | Fixed effects | Random effects | Model type | Method | DIC  | ΔDIC |
|-------|---------------|----------------|------------|--------|------|------|
| 1     | ploidy/taxon/population | ploidy/taxon/population | LMM | REML\(^a\) |  |  |
| 2     | climatic niche distance + garden + ploidy | ploidy/taxon/population | LMM | Bayesian\(^b\) | -426.0 | 0 |
| 3     | + ploidy:climatic niche distance + ploidy:climatic niche distance | taxon/population + phylo | PLMM | Bayesian\(^b\) | -424.9 | 1.1 |
| 4     | + ploidy:climatic niche distance | phylo | PLMM | Bayesian\(^b\) | -352.9 | 73.05 |

LMM, general linear mixed model
PLMM, phylogenetic general linear mixed model
REML, restricted maximum likelihood
\(^a\)using lme4 package; \(^b\)using MCMCglmm package

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**Fig. S7 Central leaflet width was similar among diploid and polyploid *Fragaria* taxa.** Individual dots represent genotypic values of each taxon in the three common gardens. The boxes denote the 25th, 50th (median) and 75th percentiles, and whiskers mark 1.5 times the interquartile range from the boxes.
**Fig. S8 Similar scales of three fitness components.** Genotypic median values of survival rate (median = 1), growth (i.e. plant size since transplanting; median = 0.64 dm²) and asexual reproduction (i.e. stolon dry mass; 0.56 g), together with the 25th and 75th percentiles, are marked by the boxes. The whiskers mark the range of the 10th and 90th percentiles.
### Table S1 Genotypes and populations of diploid and polyploid *Fragaria*

| Ploidy   | Taxon                          | Population | Genotype | Clone | Latitude      | Longitude     | Altitude (m) |
|----------|-------------------------------|------------|----------|-------|---------------|--------------|--------------|
| diploid  | *F. vesca* ssp. americana     | NA.IA.1    | 2        | 23    | 41.7753       | -94.4646     | 362          |
| diploid  | *F. vesca* ssp. americana     | NA.NH.3    | 4        | 47    | 44.8710       | -71.5036     | 339          |
| diploid  | *F. vesca* ssp. americana     | NA.ON.2    | 4        | 48    | 43.4727       | -80.0803     | 307          |
| diploid  | *F. vesca* ssp. bracteata     | NA.BC.2    | 1        | 12    | 48.7990       | -123.1370    | 188          |
| diploid  | *F. vesca* ssp. bracteata     | NA.CA.1    | 4        | 48    | 38.7751       | -120.4570    | 1075         |
| diploid  | *F. vesca* ssp. bracteata     | NA.CA.7    | 4        | 48    | 40.8961       | -123.7700    | 850          |
| diploid  | *F. vesca* ssp. bracteata     | NA.CO.2    | 4        | 48    | 38.7615       | -106.7670    | 2833         |
| diploid  | *F. vesca* ssp. bracteata     | NA.ID.1    | 4        | 48    | 44.0270       | -115.8550    | 1146         |
| diploid  | *F. vesca* ssp. bracteata     | NA.OR.3    | 4        | 48    | 44.4348       | -120.3370    | 1573         |
| diploid  | *F. vesca* ssp. bracteata     | NA.OR.4    | 4        | 48    | 44.4955       | -123.5450    | 763          |
| diploid  | *F. vesca* ssp. bracteata     | NA.OR.8    | 4        | 48    | 42.5768       | -124.3900    | 130          |
| diploid  | *F. vesca* ssp. bracteata     | NA.UT.3    | 4        | 48    | 40.4349       | -111.6310    | 2313         |
| diploid  | *F. vesca* ssp. bracteata     | NA.WA.2    | 4        | 41    | 48.4819       | -118.7270    | 629          |
| diploid  | *F. vesca* ssp. bracteata     | NA.WA.3    | 4        | 48    | 47.9640       | -117.1010    | 912          |
| diploid  | *F. vesca* ssp. vesca         | EU.AT.1    | 3        | 36    | 47.8114       | 13.0867      | 558          |
| diploid  | *F. vesca* ssp. vesca         | EU.CH.5    | 4        | 48    | 46.4909       | 6.8235       | 915          |
| diploid  | *F. vesca* ssp. vesca         | EU.CZ.1    | 4        | 48    | 50.1550       | 12.2186      | 632          |
| diploid  | *F. vesca* ssp. vesca         | EU.DE.5    | 4        | 47    | 47.8636       | 7.8543       | 833          |
| diploid  | *F. vesca* ssp. vesca         | EU.ES.1    | 4        | 48    | 41.2292       | -3.4214      | 1498         |
| diploid  | *F. vesca* ssp. vesca         | EU.ES.5    | 4        | 48    | 42.0957       | 0.6254       | 1051         |
| diploid  | *F. vesca* ssp. vesca         | EU.FI.4    | 4        | 48    | 46.2333       | 25.7000      | 113          |
| diploid  | *F. vesca* ssp. vesca         | EU.FR.3    | 4        | 48    | 43.3051       | -1.2410      | 242          |
| diploid  | *F. vesca* ssp. vesca         | EU.HR.1    | 4        | 48    | 45.8680       | 15.8462      | 128          |
| diploid  | *F. vesca* ssp. vesca         | EU.IT.1    | 4        | 48    | 46.1636       | 10.9217      | 2100         |
| diploid  | *F. vesca* ssp. vesca         | EU.NO.1    | 4        | 48    | 60.4119       | 10.5330      | 240          |
| diploid  | *F. vesca* ssp. vesca         | EU.PL.3    | 4        | 48    | 54.2795       | 18.0036      | 178          |
| diploid  | *F. vesca* ssp. vesca         | EU.RO.1    | 4        | 48    | 46.4367       | 23.7638      | 347          |
| diploid  | *F. vesca* ssp. vesca         | EU.SE.1    | 4        | 42    | 55.5222       | 14.0158      | 40           |
| diploid  | *F. vesca* ssp. vesca         | EU.SE.5    | 4        | 48    | 57.7889       | 11.8332      | 13           |
| diploid  | *F. vesca* ssp. vesca         | EU.SI.2    | 4        | 48    | 46.5769       | 15.6092      | 332          |
| diploid  | *F. viridis*                  | EU.AT.5    | 1        | 12    | 48.2331       | 14.8897      | 230          |
| diploid  | *F. viridis*                  | EU.CZ.4    | 4        | 48    | 50.5508       | 14.3697      | 320          |
| diploid  | *F. viridis*                  | EU.CZ.7    | 4        | 48    | 50.4067       | 13.8067      | 294          |
| diploid  | *F. viridis*                  | EU.DE.2    | 4        | 48    | 49.8042       | 7.7410       | 183          |
| diploid  | *F. viridis*                  | EU.ES.2    | 4        | 48    | 41.4269       | -3.7666      | 1169         |
| diploid  | *F. viridis*                  | EU.NO.3    | 4        | 48    | 60.4332       | 10.4990      | 211          |
| Species                      | Collection | Samples | Averages | Standard Deviation | Count |
|------------------------------|------------|---------|----------|--------------------|-------|
| diploid *F. viridis*         | EU.SE.1    | 4       | 48       | 55.5222            | 14.0158 | 40 |
| diploid *F. viridis*         | EU.SE.10   | 1       | 12       | 59.9255            | 17.6264 | 21 |
| diploid *F. iinumae*         | JP.HK.3    | 4       | 48       | 42.8477            | 141.0960 | 922 |
| diploid *F. iinumae*         | JP.HK.7    | 3       | 36       | 42.8685            | 140.6760 | 795 |
| polyploid *F. moschata*      | EU.AT.4    | 4       | 45       | 47.8125            | 13.0989 | 672 |
| polyploid *F. moschata*      | EU.CZ.6    | 1       | 12       | 50.5200            | 14.3625 | 285 |
| polyploid *F. moschata*      | EU.SI.1    | 4       | 48       | 46.6827            | 16.2951 | 213 |
| polyploid *F. moschata*      | EU.SI.3    | 4       | 48       | 46.2847            | 15.5876 | 626 |
| polyploid *F. virginiana ssp. platypetala* | NA.CA.12 | 3       | 36       | 40.1418            | -121.2670 | 1323 |
| polyploid *F. virginiana ssp. platypetala* | NA.OR.3  | 4       | 48       | 44.4348            | -120.3370 | 1573 |
| polyploid *F. virginiana ssp. platypetala* | NA.UT.2  | 4       | 48       | 40.3149            | -111.2590 | 2434 |
| polyploid *F. virginiana ssp. platypetala* | NA.WA.1  | 4       | 47       | 47.5269            | -121.0790 | 1022 |
| polyploid *F. virginiana ssp. virginiana* | NA.AB.2  | 4       | 47       | 50.6129            | -115.1200 | 1697 |
| polyploid *F. virginiana ssp. virginiana* | NA.AK.4  | 4       | 48       | 64.7293            | -148.1640 | 120 |
| polyploid *F. virginiana ssp. virginiana* | NA.CO.1  | 4       | 48       | 38.1133            | -106.9320 | 3041 |
| polyploid *F. virginiana ssp. virginiana* | NA.MI.2  | 4       | 48       | 44.6271            | -84.5132 | 349 |
| polyploid *F. virginiana ssp. virginiana* | NA.NY.1  | 4       | 48       | 41.8640            | -74.3461 | 384 |
| polyploid *F. virginiana ssp. virginiana* | NA.ON.1  | 4       | 48       | 45.5701            | -78.4340 | 403 |
| polyploid *F. virginiana ssp. virginiana* | NA.ON.2  | 4       | 48       | 43.4727            | -80.8030 | 307 |
| polyploid *F. virginiana ssp. virginiana* | NA.PA.1  | 4       | 48       | 41.6415            | -80.4329 | 310 |
| polyploid *F. virginiana ssp. virginiana* | NA.VT.1  | 4       | 48       | 42.8852            | -73.1156 | 417 |
| polyploid *F. virginiana ssp. virginiana* | NA.WI.1  | 2       | 24       | 45.2327            | -90.6861 | 392 |
| polyploid *F. chiloensis ssp. pacifica* | NA.AK.1  | 4       | 39       | 58.4290            | -135.7610 | 21 |
| polyploid *F. chiloensis ssp. pacifica* | NA.CA.10 | 4       | 39       | 38.3139            | -123.0470 | 4 |
| polyploid *F. chiloensis ssp. pacifica* | NA.CA.11 | 3       | 22       | 36.3305            | -121.8920 | 38 |
| polyploid *F. chiloensis ssp. pacifica* | NA.CA.2  | 5       | 49       | 37.4666            | -122.4450 | 11 |
| polyploid *F. chiloensis ssp. pacifica* | NA.CA.8  | 4       | 45       | 39.4616            | -123.8070 | 18 |
| polyploid *F. chiloensis ssp. pacifica* | NA.CA.9  | 4       | 34       | 40.7730            | -124.2140 | 3 |
| polyploid *F. chiloensis ssp. pacifica* | NA.OR.1  | 4       | 38       | 44.9167            | -124.0270 | 5 |
| polyploid *F. chiloensis ssp. chiloensis* | SA.CL.2  | 4       | 48       | -45.5500           | -72.0667 | 268 |
| polyploid *F. chiloensis ssp. chiloensis* | SA.CL.3  | 4       | 48       | -37.6333           | -73.4333 | 162 |
| polyploid *F. chiloensis ssp. chiloensis* | SA.CL.4  | 4       | 48       | -38.7333           | -71.2500 | 1255 |
| polyploid *F. chiloensis ssp. chiloensis* | SA.CL.5  | 4       | 48       | -40.5333           | -73.2333 | 11 |
| polyploid *F. cascadensis*    | NA.OR.5   | 4       | 48       | 44.4036            | -122.0760 | 1080 |
| polyploid *F. cascadensis*    | NA.OR.7   | 4       | 48       | 44.5779            | -122.1230 | 1267 |
| **Sum**                      |            | 269     | 3137     |                    |       |
Table S2 Soil properties of the three common gardens

| Unit   | Variable | Newport | Corvallis | Bend | Method                      |
|--------|----------|---------|-----------|------|-----------------------------|
| %      | Sand     | 89      | 59        | 65   | Hydrometer method           |
| %      | Silt     | 6       | 32        | 28   |                             |
| %      | Clay     | 5       | 9         | 7    |                             |
| %      | Moisture | 0.4     | 1.2       | 0.6  |                             |
| %      | C        | 0.93    | 0.59      | 0.59 |                             |
| ratio  | N        | 0.07    | 0.09      | 0.07 | Elementar                   |
|        | C:N      | 13.3    | 6.6       | 8.4  |                             |
| ppm = mg nutrient/kg soil | NO3-N   | 1.71    | 5.49      | 2.87 | Lachat                      |
|        | P        | 12.1    | 33.1      | 29.0 |                             |
|        | K        | 41      | 106       | 449  |                             |
|        | S        | 530     | 650       | 740  |                             |
|        | Ca       | 241     | 1873      | 1651 |                             |
|        | Mg       | 41      | 485       | 386  | Mehlich 3 Extraction       |
|        | Mn       | 2.4     | 39.4      | 70.4 |                             |
|        | Cu       | 1.4     | 4.9       | 4.1  |                             |
|        | Zn       | 0.3     | 2.1       | 3.0  |                             |
|        | Fe       | 12.5    | 25.6      | 16.0 |                             |
|        | B        | 0.3     | 0.3       | 0.5  |                             |

Soils were collected from each garden in June 2016, and were sent to the Central Analytical Laboratory at Oregon State University for analysis.
Table S3 Pairwise correlations between trait means and trait plasticities for diploids and polyploids

| Pairwise comparison |  | All |  |  | Diploids |  |  | Polyploids |  |  |
|---------------------|---|-----|---|---|----------|---|---|------------|---|---|
|                     |  | Correlation coefficient |  |  | Correlation coefficient |  |  | Correlation coefficient |  |  |
|                     |  | (r) | P value |  | (r) | P value |  | (r) | P value |  |
| SLA.RDPI SLA.mean   |  | 0.08 | 0.210 | -0.02 | 0.782 | 0.17 | 0.075 |
| SD.RDPI SD.mean    |  | 0.03 | 0.612 | -0.01 | 0.872 | 0.06 | 0.499 |
| SL.RDPI SL.mean    |  | 0.10 | 0.111 | -0.15 | 0.071 | 0.10 | 0.285 |
| VLA.RDPI VLA.mean  |  | 0.01 | 0.864 | -0.08 | 0.372 | 0.14 | 0.155 |
| TD.RDPI TD.mean    |  | -0.17 | 0.010 | -0.21 | 0.018 | -0.19 | 0.057 |
| Δ\textsuperscript{13}C.RDPI Δ\textsuperscript{13}C.mean |  | -0.02 | 0.889 | 0.14 | 0.408 | -0.11 | 0.573 |
| N\textsubscript{mass}.RDPI N\textsubscript{mass}.mean |  | -0.11 | 0.363 | -0.10 | 0.549 | -0.11 | 0.572 |

Non-parametric Kendall rank correlation coefficient (r) was estimated using the R package psych (Revelle, 2017). Functional trait mean was genotypic trait value averaged across all garden environments.
Table S4 Differences in leaf functional traits between diploids and polyploids

| Functional trait | Fixed effects (Predictors) | Sum Sq | df | F   | Pr(>F) |
|------------------|---------------------------|--------|----|-----|--------|
| SLA              | central leaflet width     | 36.36  | 1  | 10.38 | 0.001  |
|                  | climatic niche distance   | 11.00  | 1  | 3.14  | 0.077  |
|                  | garden                    | 712.47 | 2  | 101.66 < 2.2e-16 | 0.000  |
|                  | ploidy                    | 10.87  | 1  | 3.10  | 0.100  |
|                  | ploidy:garden             | 55.94  | 2  | 7.98  | 0.000  |
|                  | ploidy:climatic niche     | 5.11   | 1  | 1.46  | 0.228  |
|                  | distance                  |        |    |       |        |
|                  | $R^2_m$: 0.448            |        |    |       |        |
|                  | $R^2_c$: 0.750            |        |    |       |        |
| SL (log)         | central leaflet width     | 0.001  | 1  | 0.06  | 0.805  |
|                  | climatic niche distance   | 0.008  | 1  | 0.49  | 0.486  |
|                  | garden                    | 3.093  | 2  | 91.38 < 2.2e-16 | 0.000  |
|                  | ploidy                    | 0.636  | 1  | 37.56 | 0.000  |
|                  | ploidy:garden             | 0.606  | 2  | 17.90 | 0.000  |
|                  | ploidy:climatic niche     | 0.036  | 1  | 2.13  | 0.145  |
|                  | distance                  |        |    |       |        |
|                  | $R^2_m$: 0.594            |        |    |       |        |
|                  | $R^2_c$: 0.700            |        |    |       |        |
| SD (sqrt)        | central leaflet width     | 0.37   | 1  | 0.12  | 0.734  |
|                  | climatic niche distance   | 14.82  | 1  | 4.60  | 0.032  |
|                  | garden                    | 83.61  | 2  | 12.96 | 0.000  |
|                  | ploidy                    | 13.55  | 1  | 4.20  | 0.049  |
|                  | ploidy:garden             | 37.91  | 2  | 5.88  | 0.003  |
|                  | ploidy:climatic niche     | 3.11   | 1  | 0.96  | 0.327  |
|                  | distance                  |        |    |       |        |
|                  | $R^2_m$: 0.105            |        |    |       |        |
|                  | $R^2_c$: 0.346            |        |    |       |        |
| VLA (log)        | central leaflet width     | 0.239  | 1  | 8.43  | 0.004  |
|                  | climatic niche distance   | 0.110  | 1  | 3.89  | 0.050  |
|                  | garden                    | 0.455  | 1  | 16.02 | 0.000  |
|                  | ploidy                    | 0.135  | 1  | 4.74  | 0.037  |
|                  | ploidy:garden             | 0.008  | 1  | 0.28  | 0.597  |
|                  | ploidy:climatic niche     | 0.035  | 1  | 1.25  | 0.265  |
|                  | distance                  |        |    |       |        |
|                  | $R^2_m$: 0.359            |        |    |       |        |
|                  | $R^2_c$: 0.530            |        |    |       |        |
| TD (sqrt)                | Central leaflet width | 2.43 | 1 | 10.96 | 0.001 |
|-------------------------|-----------------------|------|---|-------|-------|
|                         | Climatic niche distance | 0.46 | 1 | 2.09  | 0.149 |
|                         | Garden                | 70.03| 1 | 316.10| 2.2e-16|
|                         | Ploidy                | 0.21 | 1 | 0.96  | 0.346 |
|                         | Ploidy:garden         | 1.83 | 1 | 8.26  | 0.004 |
|                         | Ploidy:climatic niche distance | 0.01 | 1 | 0.04  | 0.840 |
|                         | R²_m: 0.249           |      |   |       |       |
|                         | R²_c: 0.799           |      |   |       |       |
| N_mass                  | Central leaflet width | 0.79 | 1 | 4.64  | 0.033 |
|                         | Climatic niche distance | 0.02 | 1 | 0.10  | 0.747 |
|                         | Garden                | 29.12| 2 | 85.21<br>2e-16 |
|                         | Ploidy                | 0.10 | 1 | 0.57  | 0.453 |
|                         | Ploidy:garden         | 1.02 | 2 | 2.99  | 0.053 |
|                         | Ploidy:climatic niche distance | 0.15 | 1 | 0.88  | 0.349 |
|                         | R²_m: 0.660           |      |   |       |       |
|                         | R²_c: 0.701           |      |   |       |       |
| Δ¹³C                    | Central leaflet width | 1.14 | 1 | 2.22  | 0.138 |
|                         | Climatic niche distance | 4.25 | 1 | 8.30  | 0.004 |
|                         | Garden                | 19.79| 2 | 19.34 | 0.000 |
|                         | Ploidy                | 0.75 | 1 | 1.46  | 0.233 |
|                         | Ploidy:garden         | 1.50 | 2 | 1.47  | 0.234 |
|                         | Ploidy:climatic niche distance | 1.10 | 1 | 2.15  | 0.144 |
|                         | R²_m: 0.220           |      |   |       |       |
|                         | R²_c: 0.448           |      |   |       |       |

General linear mixed model (LMM) specification:
model <- lmer(Functional trait ~ Fixed effects + (1 | Nested random effects) )
Fixed effects: central leaflet width + climatic niche distance + garden + ploidy + ploidy:garden + ploidy:climatic niche distance
Nested random effects: ploidy/taxon/population
The response variable of each LMM was power transformed if necessary. $R^2_m$, model marginal $R^2$ representing variance explained by fixed effects; $R^2_c$, model conditional $R^2$ representing variance explained by both fixed effects and random effects.
Table S5 Pairwise correlations between trait plasticities and between functional traits for each taxon

| Taxon                  | Trait | Trait | Correlation coefficient (r) | P value | Trait | Trait | Correlation coefficient (r) | P value |
|------------------------|-------|-------|-----------------------------|---------|-------|-------|-----------------------------|---------|
| *Fragaria vesca* ssp. *americana* | SLA   | SD    | -0.11                       | 0.760   | -0.24 | 0.496 |
|                        | SLA   | SL    | -0.07                       | 0.855   | 0.16  | 0.668 |
|                        | SD    | SL    | -0.11                       | 0.760   | 0.07  | 0.855 |
|                        | SLA   | VLA   | -0.11                       | 0.776   | -0.06 | 0.887 |
|                        | SD    | VLA   | 0.22                        | 0.566   | -0.50 | 0.170 |
|                        | SL    | VLA   | 0.39                        | 0.301   | -0.28 | 0.469 |
|                        | SLA   | TD    | 0.39                        | 0.301   | 0.33  | 0.381 |
|                        | SD    | TD    | 0.17                        | 0.668   | -0.44 | 0.231 |
|                        | SL    | TD    | -0.11                       | 0.776   | -0.11 | 0.776 |
|                        | VLA   | TD    | 0.06                        | 0.887   | 0.50  | 0.170 |
|                        | SLA   | $\Delta^{13}$C | -0.33 | 0.784 | 0.33 | 0.784 |
|                        | SD    | $\Delta^{13}$C | -0.33 | 0.784 | -0.33 | 0.784 |
|                        | SL    | $\Delta^{13}$C | -0.33 | 0.784 | 1.00 | **0.000** |
|                        | VLA   | $\Delta^{13}$C | 0.33 | 0.784 | -0.33 | 0.784 |
|                        | TD    | $\Delta^{13}$C | 0.33 | 0.784 | -0.33 | 0.784 |
|                        | SLA   | N$_{mass}$ | -0.33 | 0.784 | 1.00 | **0.000** |
|                        | SD    | N$_{mass}$ | 1.00 | **0.000** | -1.00 | **0.000** |
|                        | SL    | N$_{mass}$ | 1.00 | **0.000** | 0.33 | 0.784 |
|                        | VLA   | N$_{mass}$ | 0.33 | 0.784 | 0.33 | 0.784 |
|                        | TD    | N$_{mass}$ | -1.00 | **0.000** | 0.33 | 0.784 |
|                        | $\Delta^{13}$C | N$_{mass}$ | -0.33 | 0.784 | 0.33 | 0.784 |
| *Fragaria vesca* ssp. *bracteata* | SLA   | SD    | -0.02                       | 0.893   | -0.10 | 0.522 |
|                        | SLA   | SL    | -0.01                       | 0.972   | 0.14  | 0.361 |
|                        | SD    | SL    | -0.11                       | 0.484   | -0.15 | 0.337 |
|                        | SLA   | VLA   | 0.01                        | 0.975   | 0.15  | 0.484 |
|                        | SD    | VLA   | -0.24                       | 0.248   | -0.15 | 0.484 |
|                        | SL    | VLA   | -0.18                       | 0.389   | -0.20 | 0.338 |
|                        | SLA   | TD    | -0.05                       | 0.800   | 0.07  | 0.728 |
|                        | SD    | TD    | 0.02                        | 0.924   | 0.03  | 0.874 |
|                        | SL    | TD    | -0.13                       | 0.525   | -0.19 | 0.354 |
|                        | VLA   | TD    | 0.07                        | 0.728   | 0.34  | 0.096 |
|                        | SLA   | $\Delta^{13}$C | -0.24 | 0.496 | -0.24 | 0.496 |
|                        | SD    | $\Delta^{13}$C | 0.38 | 0.282 | 0.24 | 0.496 |
|                        | SL    | $\Delta^{13}$C | -0.02 | 0.951 | 0.07 | 0.855 |
|      | Δ¹³C  | N_{mass} |      | Δ¹³C  | N_{mass} |
|------|-------|----------|------|-------|----------|
| VLA  | -0.50 | 0.170    | 0.06 | 0.887 |
| TD   | -0.22 | 0.566    | 0.22 | 0.566 |
| SL   | 0.56  | 0.095    | 0.04 | 0.902 |
| SD   | -0.16 | 0.668    | 0.31 | 0.376 |
| SL   | 0.33  | 0.347    | -0.09| 0.805 |
| VLA  | 0.28  | 0.469    | -0.33| 0.381 |
| TD   | -0.11 | 0.776    | -0.06| 0.887 |
| Δ¹³C | -0.42 | 0.224    | 0.27 | 0.451 |

| Fragaria vesca ssp. vesca |
|--------------------------|
| SL | SD  | 0.02 | 0.889 | 0.10 | 0.429 |
| SL | SL  | 0.06 | 0.624 | -0.03| 0.833 |
| SD | SL  | 0.08 | 0.531 | -0.07| 0.588 |
| SL | VLA | -0.11| 0.386 | 0.05 | 0.687 |
| SD | VLA | 0.06 | 0.630 | 0.15 | 0.226 |
| SL | VLA | -0.07| 0.613 | -0.16| 0.216 |
| SL | TD  | 0.00 | 0.978 | -0.04| 0.741 |
| SD | TD  | 0.04 | 0.783 | -0.10| 0.429 |
| SL | TD  | 0.10 | 0.441 | -0.03| 0.833 |
| VLA| TD  | 0.11 | 0.377 | 0.14 | 0.282 |
| SL | Δ¹³C| -0.12| 0.667 | 0.37 | 0.162 |
| SD | Δ¹³C| 0.10 | 0.713 | -0.05| 0.854 |
| SL | Δ¹³C| 0.25 | 0.350 | 0.08 | 0.759 |
| VLA| Δ¹³C| -0.13| 0.623 | 0.18 | 0.497 |
| TD | Δ¹³C| -0.15| 0.579 | 0.02 | 0.951 |
| SL | N_{mass} | 0.03 | 0.902 | -0.10| 0.713 |
| SD | N_{mass} | 0.22 | 0.420 | 0.12 | 0.667 |
| SL | N_{mass} | 0.13 | 0.623 | -0.08| 0.759 |
| VLA| N_{mass} | 0.02 | 0.951 | -0.18| 0.497 |
| TD | N_{mass} | 0.30 | 0.259 | 0.05 | 0.854 |
| Δ¹³C| N_{mass} | -0.05| 0.854 | -0.37| 0.162 |

| Fragaria viridis |
|------------------|
| SL | SD  | 0.08 | 0.687 | -0.02| 0.917 |
| SL | SL  | -0.08| 0.704 | 0.22 | 0.284 |
| SD | SL  | -0.21| 0.306 | 0.03 | 0.870 |
| SL | VLA | 0.11 | 0.613 | -0.02| 0.920 |
| SD | VLA | -0.01| 0.973 | -0.03| 0.893 |
| SL | VLA | 0.16 | 0.460 | 0.04 | 0.867 |
| SL | TD  | 0.02 | 0.920 | 0.05 | 0.814 |
| SD | TD  | -0.01| 0.973 | 0.00 | 1.000 |
| SL | TD  | 0.32 | 0.136 | -0.17| 0.436 |
| VLA| TD  | 0.10 | 0.637 | 0.14 | 0.499 |
| SL | Δ¹³C| 0.07 | 0.867 | -0.29| 0.493 |
| SD | Δ¹³C| 0.21 | 0.610 | -0.29| 0.493 |
| SL | Δ¹³C| -0.36| 0.385 | 0.00 | 1.000 |
|      | VLA | TD  | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|------|-----|-----|-----|-----|-----|-----|-----|------|--------|
|      | Δ¹³C|-- | 0.36 | 0.21 | -0.07 | 0.867 | 0.610 |      |        |
|      | 0.21 | 0.867 | 0.50 | 0.207 | 0.14 | 0.36 | 0.867 |      |        |
|      | 0.14 | 0.736 | 0.43 | 0.337 | 0.33 | 0.337 | 0.33 |      |        |

|      | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|------|-----|-----|-----|-----|-----|------|--------|
|      | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|      | SLA | SL  | SD  | SL  | SL  | VLA | TD  | Δ¹³C | N_mass |
|      | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|      | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|      | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |

**Fragaria iinumae**

|      | VLA | TD  | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|------|-----|-----|-----|-----|-----|-----|-----|------|--------|
|      | Δ¹³C|-- | 0.36 | 0.21 | -0.07 | 0.867 | 0.610 |      |        |
|      | 0.21 | 0.867 | 0.50 | 0.207 | 0.14 | 0.36 | 0.867 |      |        |
|      | 0.14 | 0.736 | 0.43 | 0.337 | 0.33 | 0.337 | 0.33 |      |        |

**Fragaria moschata**

|      | VLA | TD  | SLA | SD  | SL  | VLA | TD  | Δ¹³C | N_mass |
|------|-----|-----|-----|-----|-----|-----|-----|------|--------|
|      | Δ¹³C|-- | 0.36 | 0.21 | -0.07 | 0.867 | 0.610 |      |        |
|      | 0.21 | 0.867 | 0.50 | 0.207 | 0.14 | 0.36 | 0.867 |      |        |
|      | 0.14 | 0.736 | 0.43 | 0.337 | 0.33 | 0.337 | 0.33 |      |        |
| SLA | $\Delta^{13}$C | 0.00 | 1.000 | 0.33 | 0.667 |
|-----|----------------|------|--------|------|-------|
| TD  | $\Delta^{13}$C | 0.00 | 1.000 | -0.33 | 0.667 |
| SLA | $N_{\text{mass}}$ | 0.00 | 1.000 | 0.00 | 1.000 |
| SD  | $N_{\text{mass}}$ | 0.33 | 0.667 | 0.67 | 0.333 |
| SL  | $N_{\text{mass}}$ | 0.67 | 0.333 | -0.33 | 0.667 |
| VLA | $N_{\text{mass}}$ | 0.00 | 1.000 | 0.67 | 0.333 |
| TD  | $N_{\text{mass}}$ | 0.67 | 0.333 | 0.00 | 1.000 |
| $\Delta^{13}$C | $N_{\text{mass}}$ | 0.33 | 0.667 | 0.00 | 1.000 |
| SLA | SD | 0.01 | 0.973 | -0.10 | 0.710 |
| SLA | SL | -0.05 | 0.866 | -0.01 | 0.973 |
| SD  | SL | 0.56 | **0.029** | -0.39 | 0.150 |
| SLA | VLA | -0.09 | 0.761 | 0.16 | 0.564 |
| SD  | VLA | 0.22 | 0.433 | -0.07 | 0.813 |
| SL  | VLA | 0.39 | 0.150 | -0.12 | 0.660 |
| SLA | TD | 0.12 | 0.660 | -0.01 | 0.973 |
| SD  | TD | 0.05 | 0.866 | 0.33 | 0.225 |
| SL  | TD | -0.16 | 0.564 | -0.22 | 0.433 |
| VLA | TD | -0.01 | 0.973 | -0.28 | 0.319 |
| SLA | $\Delta^{13}$C | 0.00 | 1.000 | 0.67 | 0.333 |
| SD  | $\Delta^{13}$C | 0.00 | 1.000 | 0.00 | 1.000 |
| SL  | $\Delta^{13}$C | 0.00 | 1.000 | -0.67 | 0.333 |
| VLA | $\Delta^{13}$C | 0.00 | 1.000 | -1.00 | **0.000** |
| TD  | $\Delta^{13}$C | -0.33 | 0.667 | 0.00 | 1.000 |
| SLA | $N_{\text{mass}}$ | 0.00 | 1.000 | 0.33 | 0.667 |
| SD  | $N_{\text{mass}}$ | 0.00 | 1.000 | -0.33 | 0.667 |
| SL  | $N_{\text{mass}}$ | 0.00 | 1.000 | 0.33 | 0.667 |
| VLA | $N_{\text{mass}}$ | 0.00 | 1.000 | 0.00 | 1.000 |
| TD  | $N_{\text{mass}}$ | 0.33 | 0.667 | -1.00 | **0.000** |
| $\Delta^{13}$C | $N_{\text{mass}}$ | 0.33 | 0.667 | 0.00 | 1.000 |

**Fragaria virginiana ssp. platypetala**

| SLA | SD | 0.04 | 0.793 | 0.21 | 0.211 |
|-----|----|------|--------|------|-------|
| SLA | SL | 0.07 | 0.690 | -0.28 | 0.092 |
| SD  | SL | 0.18 | 0.286 | -0.46 | **0.003** |
| SLA | VLA | -0.02 | 0.926 | 0.27 | 0.106 |
| SD  | VLA | 0.02 | 0.926 | 0.27 | 0.097 |
| SL  | VLA | -0.02 | 0.899 | -0.28 | 0.085 |
| SLA | TD | 0.15 | 0.380 | 0.07 | 0.678 |
| SD  | TD | -0.04 | 0.819 | -0.04 | 0.799 |
| SL  | TD | 0.37 | **0.021** | -0.15 | 0.371 |
| VLA | TD | 0.06 | 0.728 | 0.25 | 0.136 |
| SLA | $\Delta^{13}$C | -0.38 | 0.282 | 0.07 | 0.855 |
| SD  | $\Delta^{13}$C | 0.56 | 0.095 | 0.16 | 0.668 |
| SL  | $\Delta^{13}$C | 0.07 | 0.855 | 0.24 | 0.496 |
|     | $\Delta^{13}C$ | $N_{mass}$ | $\Delta^{13}C$ | $N_{mass}$ |
|-----|----------------|-----------|----------------|-----------|
| VLA | -0.02          | 0.951     | -0.42          | 0.224     |
| TD  | -0.20          | 0.580     | -0.07          | 0.855     |
| SLA | 0.20           | 0.580     | -0.20          | 0.580     |
| SD  | -0.20          | 0.580     | 0.07           | 0.855     |
| SL  | 0.02           | 0.951     | 0.16           | 0.668     |
| VLA | -0.16          | 0.668     | -0.33          | 0.347     |
| TD  | 0.20           | 0.580     | -0.33          | 0.347     |
| $\Delta^{13}C$ | 0.02    | 0.951     | 0.29           | 0.418     |

**Fragaria chiloensis**  
ssp. pacifica

|     | $\Delta^{13}C$ | $N_{mass}$ | $\Delta^{13}C$ | $N_{mass}$ |
|-----|----------------|-----------|----------------|-----------|
| SLA | SD             | 0.06      | 0.754          | 0.06      |
|     | SL             | 0.11      | 0.601          | -0.19     |
|     | SD             | -0.08     | 0.709          | -0.27     |
|     | SL             | 0.32      | 0.140          | -0.08     |
|     | SD             | -0.16     | 0.476          | 0.11      |
|     | SL             | -0.18     | 0.429          | -0.05     |
|     | SLA            | TD         | 0.07           | 0.774     |
|     | SD             | TD         | 0.07           | 0.774     |
|     | SL             | TD         | -0.02          | 0.935     |
|     | VLA            | TD         | -0.43          | 0.053     |
|     | SLA            | $\Delta^{13}C$ | 0.24           | 0.607     |
|     | SD             | $\Delta^{13}C$ | 0.33           | 0.465     |
|     | SL             | $\Delta^{13}C$ | -0.33          | 0.465     |
|     | VLA            | $\Delta^{13}C$ | 0.05           | 0.919     |
|     | TD             | $\Delta^{13}C$ | 0.24           | 0.607     |
|     | SLA            | $N_{mass}$ | 0.43           | 0.337     |
|     | SD             | $N_{mass}$ | -0.24          | 0.607     |
|     | SL             | $N_{mass}$ | -0.14          | 0.760     |
|     | VLA            | $N_{mass}$ | -0.14          | 0.760     |
|     | TD             | $N_{mass}$ | 0.43           | 0.337     |
| $\Delta^{13}C$ | $N_{mass}$ | 0.43 | 0.337 | -0.62 | 0.138 |

**Fragaria chiloensis**  
ssp. chiloensis

|     | $\Delta^{13}C$ | $N_{mass}$ | $\Delta^{13}C$ | $N_{mass}$ |
|-----|----------------|-----------|----------------|-----------|
| SLA | SD             | -0.10     | 0.713          | -0.20     |
|     | SL             | -0.05     | 0.854          | 0.13      |
|     | SD             | 0.15      | 0.579          | -0.27     |
|     | SL             | -0.05     | 0.873          | 0.24      |
|     | SD             | 0.05      | 0.873          | 0.02      |
|     | SL             | -0.02     | 0.958          | -0.09     |
|     | SLA            | TD         | -0.36          | 0.245     |
|     | SD             | TD         | 0.27           | 0.391     |
|     | SL             | TD         | 0.42           | 0.169     |
|     | VLA            | TD         | -0.16          | 0.631     |
|     | SLA            | $\Delta^{13}C$ | -0.33          | 0.667     |
|     | SD             | $\Delta^{13}C$ | 0.67           | 0.333     |
|     | SL             | $\Delta^{13}C$ | -0.33          | 0.667     |
|       | VLA   | Δ\(^{13}\)C | TD    | Δ\(^{13}\)C | SLA   | N\(_{\text{mass}}\) | SD    | N\(_{\text{mass}}\) | SL    | N\(_{\text{mass}}\) | VLA   | N\(_{\text{mass}}\) | TD    | N\(_{\text{mass}}\) | Δ\(^{13}\)C | N\(_{\text{mass}}\) |
|-------|-------|-------------|-------|-------------|-------|----------------|-------|----------------|-------|----------------|-------|----------------|-------|----------------|-------------|----------------|
| SLA   | 0.33  | 0.784       | 0.33  | 0.784       | -0.33 | 0.667         | 0.67  | 0.333         | -0.33 | 0.667         | 1.00  | 0.000         | 0.33  | 0.667         | -0.33       | 0.667         |
| SD    | 0.67  | 0.333       | 0.67  | 0.333       | -0.67 | 0.333         | 0.67  | 0.333         | -0.67 | 0.333         | 1.00  | 0.000         | 0.67  | 0.333         | 0.67        | 0.333         |
| SL    | 1.00  | \textbf{0.000} | -0.33 | 0.667       | 1.00  | 0.000         | 0.33  | 0.667         | 1.00  | \textbf{0.000} | 0.33  | 0.667         | 1.00  | \textbf{0.000} | 0.33        | 0.667         |
| VLA   | 0.67  | 0.333       | 0.67  | 0.333       | 0.33  | 0.667         | 0.67  | 0.333         | 0.33  | 0.667         | 0.67  | 0.333         | 0.67  | 0.333         | 0.67        | 0.333         |

*Fragaria cascadensis*

|       | SLA   | SD          | 0.21  | 0.610       | -0.36 | 0.385         | 0.29  | 0.493         | 0.00  | 1.000         | 0.00  | 1.000         | 0.00  | 1.000         | 0.00        | 1.000         |
|-------|-------|-------------|-------|-------------|-------|----------------|-------|----------------|-------|----------------|-------|----------------|-------|----------------|-------------|----------------|
| SLA   | 0.07  | 0.867       | -0.50 | 0.207       | -0.50 | 0.207         | 0.64  | 0.086         | 0.50  | 0.207         | 0.50  | 0.207         | 0.50  | 0.207         | 0.50        | 0.207         |
| SD    | 0.00  | 1.000       | -0.14 | 0.736       | -0.14 | 0.736         | 0.36  | 0.385         | -0.36 | 0.385         | -0.36 | 0.385         | -0.36 | 0.385         | -0.36       | 0.385         |
| SL    | 0.00  | 1.000       | 0.36  | 0.385       | 0.36  | 0.385         | 0.07  | 0.867         | 0.14  | 0.736         | 0.14  | 0.736         | 0.14  | 0.736         | 0.14        | 0.736         |
| VLA   | 0.07  | 0.867       | -0.29 | 0.493       | -0.29 | 0.493         | 0.14  | 0.736         | 0.07  | 0.867         | 0.07  | 0.867         | 0.07  | 0.867         | 0.07        | 0.867         |

Non-parametric Kendall rank correlation coefficient (r) was estimated using the R package `psych` (Revelle, 2017). Functional trait mean was genotypic trait value averaged across all garden environments. Missing r values were due to few data for carbon isotope discrimination and nitrogen content in some taxa.
Table S6 Differences in trait plasticity between diploids and polyploids

| Plasticity index | Trait plasticity | Fixed effects (Predictors)                           | Sum Sq | df | F     | Pr(>F) |
|------------------|------------------|------------------------------------------------------|--------|----|-------|--------|
| RDPI             | SLA.RDPI         | climatic niche distance mean                         | 0.0024 | 1  | 1.00  | 0.323  |
|                  |                  | ploidy                                               | 0.0022 | 1  | 0.89  | 0.353  |
|                  |                  | climatic niche distance mean                         | 0.0021 | 1  | 0.86  | 0.358  |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.012                                         |        |    |       |        |
|                  |                  | R²_c : 0.154                                         |        |    |       |        |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.012                                         |        |    |       |        |
|                  |                  | R²_c : 0.154                                         |        |    |       |        |
| SL.RDPI          |                  | climatic niche distance mean                         | 0.0038 | 1  | 1.75  | 0.200  |
|                  |                  | ploidy                                               | 0.0035 | 1  | 1.62  | 0.221  |
|                  |                  | climatic niche distance mean                         | 0.0012 | 1  | 0.56  | 0.462  |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.051                                         |        |    |       |        |
|                  |                  | R²_c : 0.173                                         |        |    |       |        |
| SD.RDPI (sqrt)   |                  | climatic niche distance mean                         | 0.0008 | 1  | 0.06  | 0.801  |
|                  |                  | ploidy                                               | 0.0045 | 1  | 0.37  | 0.547  |
|                  |                  | climatic niche distance mean                         | 0.0153 | 1  | 1.25  | 0.273  |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.026                                         |        |    |       |        |
|                  |                  | R²_c : 0.088                                         |        |    |       |        |
| VLA.RDPI (sqrt)  |                  | climatic niche distance mean                         | 0.0170 | 1  | 1.08  | 0.305  |
|                  |                  | ploidy                                               | 0.0001 | 1  | 0.01  | 0.934  |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.006                                         |        |    |       |        |
|                  |                  | R²_c : 0.084                                         |        |    |       |        |
| TD.RDPI          |                  | climatic niche distance mean                         | 0.0009 | 1  | 0.03  | 0.865  |
|                  |                  | ploidy                                               | 0.0653 | 1  | 2.14  | 0.150  |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.015                                         |        |    |       |        |
|                  |                  | R²_c : 0.327                                         |        |    |       |        |
| N_mass.RDPI      |                  | climatic niche distance mean                         | 0.0358 | 1  | 5.51  | 0.029  |
|                  |                  | ploidy                                               | 0.0001 | 1  | 0.02  | 0.881  |
|                  |                  | ploidy:climatic niche distance mean                  |        |    |       |        |
|                  |                  | R²_m : 0.082                                         |        |    |       |        |
|                  |                  | R²_c : 0.109                                         |        |    |       |        |
| Variable | Description | Mean | ploidy | ploidy:climatic niche distance mean | $R^2_m$ | $R^2_c$ |
|----------|-------------|------|--------|-----------------------------------|---------|---------|
| $\Delta^{13}$C.RDPI (sqrt) | climatic niche distance mean | 0.0003 | 1 | 0.14 | 0.714 |
| | ploidy | 0.0011 | 1 | 0.58 | 0.459 |
| | ploidy:climatic niche distance mean | 0.0001 | 1 | 0.06 | 0.808 |
| | $R^2_m$: 0.077 |  |  |  |  |
| | $R^2_c$: 0.083 |  |  |  |  |
| PI | SLA.PI | climatic niche distance mean | 0.0024 | 1 | 0.41 | 0.526 |
| | ploidy | 0.0042 | 1 | 0.71 | 0.406 |
| | ploidy:climatic niche distance mean | 0.0038 | 1 | 0.64 | 0.427 |
| | $R^2_m$: 0.007 |  |  |  |  |
| | $R^2_c$: 0.150 |  |  |  |  |
| SL.PI | climatic niche distance mean | 0.0109 | 1 | 1.81 | 0.192 |
| | ploidy | 0.0103 | 1 | 1.70 | 0.207 |
| | ploidy:climatic niche distance mean | 0.0042 | 1 | 0.70 | 0.411 |
| | $R^2_m$: 0.043 |  |  |  |  |
| | $R^2_c$: 0.135 |  |  |  |  |
| SD.PI (sqrt) | climatic niche distance mean | 0.0085 | 1 | 0.36 | 0.551 |
| | ploidy | 0.0197 | 1 | 0.83 | 0.365 |
| | ploidy:climatic niche distance mean | 0.0358 | 1 | 1.49 | 0.223 |
| | $R^2_m$: 0.012 |  |  |  |  |
| | $R^2_c$: 0.012 |  |  |  |  |
| VLA.PI (sqrt) | climatic niche distance mean | 0.0364 | 1 | 1.00 | 0.323 |
| | ploidy | 0.0000 | 1 | 0.00 | 0.982 |
| | ploidy:climatic niche distance mean | 0.0000 | 1 | 0.00 | 0.979 |
| | $R^2_m$: 0.006 |  |  |  |  |
| | $R^2_c$: 0.086 |  |  |  |  |
| TD.PI | climatic niche distance mean | 0.0001 | 1 | 0.00 | 0.968 |
| | ploidy | 0.1507 | 1 | 3.09 | 0.084 |
| | ploidy:climatic niche distance mean | 0.1595 | 1 | 3.27 | 0.075 |
| | $R^2_m$: 0.017 |  |  |  |  |
| | $R^2_c$: 0.060 |  |  |  |  |
| $N_{mass}.PI$ | climatic niche distance mean | 0.0709 | 1 | 6.25 | 0.022 |
| | ploidy | 0.0001 | 1 | 0.01 | 0.919 |
| | ploidy:climatic niche distance mean | 0.0001 | 1 | 0.01 | 0.932 |
| | $R^2_m$: 0.087 |  |  |  |  |
| | $R^2_c$: 0.093 |  |  |  |  |
$Δ^{13}C\text{PI (sqrt)}$  

|                          | climatic niche distance mean | ploidy                  | ploidy:climatic niche distance mean |
|--------------------------|------------------------------|-------------------------|-------------------------------------|
|                          | 0.0003                       | 1                       | 0.09                                 |
|                          |                              | 0.0027                  | 1                                   |
|                          |                              |                         | 0.772                                |
|                          |                              |                         | 0.72                                 |
|                          |                              |                         | 0.409                                |
|                          |                              |                         | 0.0005                               |
|                          |                              |                         | 1                                   |
|                          |                              |                         | 0.12                                 |
|                          |                              |                         | 0.735                                |


$R^2_m: 0.078$

$R^2_c: 0.093$

---

General linear mixed model (LMM) specification:

```r
model <- lmer(Trait plasticity ~ Fixed effects + (1 | Nested random effects))
```

Fixed effects: climatic niche distance mean (i.e. genotypic climatic niche distance averaged across all garden environments) + ploidy + ploidy:climatic niche distance mean

Nested random effects: ploidy/taxon/population

RDPI, relative distance plasticity index; PI phenotypic plasticity index. The response variable of each LMM was power transformed if necessary. $R^2_m$, model marginal $R^2$ representing variance explained by fixed effects; $R^2_c$, model conditional $R^2$ representing variance explained by both fixed effects and random effects.
Table S7 Differences in fitness between diploids and polyploids

| Fitness                  | Fixed effects (Predictors)                  | ANOVA table with Type III sums of squares |
|--------------------------|---------------------------------------------|------------------------------------------|
| (Composite fitness       | Sum Sq | df  | F     | Pr(>F) |
| climatic niche distance  | 2.23   | 1   | 71.54 | 2.22E-16 |
| garden                   | 35.08  | 2   | 562.96| < 2.2E-16 |
| ploidy                   | 0.62   | 1   | 20.02 | 7.05E-05  |
| ploidy:garden            | 0.31   | 2   | 4.99  | 0.007     |
| ploidy:climatic niche    | 0.32   | 1   | 10.24 | 0.001     |
| distance                 |        |     |       |          |
| $R^2_m$: 0.614           |        |     |       |          |
| $R^2_c$: 0.712           |        |     |       |          |

General linear mixed model (LMM) specification:

```
model <- lmer(Fitness ~ Fixed effects + (1 | Nested random effects))
```

Fixed effects: climatic niche distance + garden + ploidy + ploidy:garden + ploidy:climatic niche distance

Nested random effects: ploidy/taxon/population

The response variable of the LMM was power transformed (power parameter = 0.1). $R^2_m$, model marginal $R^2$ representing variance explained by fixed effects; $R^2_c$, model conditional $R^2$ representing variance explained by both fixed effects and random effects.
Table S8 Relationships between average fitness and trait means and trait plasticities in heterogeneous garden environments

| Functional trait model | Fixed effects (Predictors) | Sum Sq | df | F      | Pr(>F) |
|------------------------|----------------------------|--------|----|--------|--------|
| SLA                    | climatic niche distance mean | 0.055  | 1  | 2.22   | 0.141  |
|                        | SLA.RDPI                   | 0.034  | 1  | 1.37   | 0.243  |
|                        | SLA.mean                   | 0.137  | 1  | 5.57   | **0.019** |
|                        | ploidy:SLA.RDPI            | 0.004  | 1  | 0.17   | 0.681  |
|                        | ploidy:SLA.mean            | 0.049  | 1  | 1.99   | 0.175  |
|                        | $R^2_m$: 0.053             |        |    |        |        |
|                        | $R^2_c$: 0.581             |        |    |        |        |
| SL                     | climatic niche distance mean | 0.043  | 1  | 1.91   | 0.172  |
|                        | SL.RDPI                    | 0.511  | 1  | 22.72  | **0.000** |
|                        | SL.mean                    | 0.235  | 1  | 10.46  | **0.001** |
|                        | ploidy:SL.RDPI             | 0.033  | 1  | 1.47   | 0.226  |
|                        | ploidy:SL.mean             | 0.000  | 1  | 0.01   | 0.925  |
|                        | $R^2_m$: 0.253             |        |    |        |        |
|                        | $R^2_c$: 0.553             |        |    |        |        |
| SD                     | climatic niche distance mean | 0.049  | 1  | 2.01   | 0.161  |
|                        | SD.RDPI                    | 0.001  | 1  | 0.05   | 0.818  |
|                        | SD.mean                    | 0.013  | 1  | 0.55   | 0.459  |
|                        | ploidy:SD.RDPI             | 0.185  | 1  | 7.58   | **0.006** |
|                        | ploidy:SD.mean             | 0.030  | 1  | 1.23   | 0.276  |
|                        | $R^2_m$: 0.192             |        |    |        |        |
|                        | $R^2_c$: 0.539             |        |    |        |        |
| VLA                    | climatic niche distance mean | 0.008  | 1  | 0.36   | 0.553  |
|                        | VLA.RDPI                   | 0.000  | 1  | 0.00   | 0.997  |
|                        | VLA.mean                   | 0.106  | 1  | 4.69   | **0.031** |
|                        | ploidy:VLA.RDPI            | 0.085  | 1  | 3.76   | 0.054  |
|                        | ploidy:VLA.mean            | 0.159  | 1  | 7.03   | **0.015** |
|                        | $R^2_m$: 0.203             |        |    |        |        |
|                        | $R^2_c$: 0.575             |        |    |        |        |
| TD                     | climatic niche distance mean | 0.020  | 1  | 0.98   | 0.326  |
|                        | TD.RDPI                    | 0.360  | 1  | 17.62  | **0.000** |
|                        | TD.mean                    | 0.122  | 1  | 5.98   | **0.015** |
|                        | ploidy:TD.RDPI             | 0.048  | 1  | 2.36   | 0.126  |
|                        | ploidy:TD.mean             | 0.050  | 1  | 2.45   | 0.124  |
|                        | $R^2_m$: 0.265             |        |    |        |        |
General linear mixed model specification:
model <- lmer( (Fitness mean)^0.1 ~ Fixed effects + (1 | Nested random effects) )
Fixed effects: climatic niche distance mean + trait plasticity + trait mean + ploidy:trait plasticity + ploidy:trait mean, where climatic niche distance mean and trait mean represent genotypic values averaged across all garden environments
Nested random effects: ploidy/taxon/population
The response variable (genotypic fitness averaged across all garden environments) of each LMM was power transformed (power parameter = 0.1). $R^2_m$, model marginal $R^2$ representing variance explained by fixed effects; $R^2_c$, model conditional $R^2$ representing variance explained by both fixed effects and random effects.
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