Pomegranate Characteristic Study (2022–2024): Results & Figures

Cultivars: Chater, Eversweet, Phoenicia, Wonderful

Results

Across pooled years, overall liking differed by cultivar (one-way ANOVA: $F(3, 1306)=19.26$, $p=3.18e-12$, $\eta^2=0.042$). Tukey showed Chater and Wonderful > Eversweet and Phoenicia ($p<0.001$), with no difference between Chater vs Wonderful or Eversweet vs Phoenicia. Year also affected overall ratings ($F(2, 1307)=9.92$, $p=5.28e-05$, $\eta^2=0.015$); means were 2022=6.15, 2023=5.95, 2024=6.49. A multiple linear regression ($R^2=0.390$; adjusted $R^2=0.388$; VIFs$\leq$1.11) identified Sweetness as the dominant positive driver ($\beta\approx1.02$, $p<0.001$), with Color ($\beta\approx0.38$, $p<0.001$) and Texture/Hardness ($\beta\approx0.15$, $p=0.0007$) contributing modestly; Acidity was not significant ($p=0.235$). A two-way ANOVA confirmed a cultivar×year interaction for Overall ($F=5.35$, $p=1.83e-05$). The coefficient of variation for Overall was 30.5%, suggesting moderate variability in consumer scoring.

Discussion

Color

Chater consistently achieved the highest color desirability while Eversweet was lowest, with Wonderful showing the widest range. Cultivar differences persisted across years, and 2024 exhibited broader color IQRs across cultivars. Your rainy-2022 hypothesis is consistent with larger color shifts in Eversweet/Phoenicia; however, causal attribution requires agronomic covariates (rain/heat).

Acidity.

Central tendencies clustered near 5–7 across cultivars. Variability was largest for Eversweet, and acidity's weak association with Overall (non-significant regression coefficient) suggests it should not be prioritized in selection without context (e.g., niche preferences).

Sweetness & year effects.

Sweetness dipped in 2023 across cultivars, mirroring lower Overall means, while peaks in sweetness did not coincide with acidity peaks. Chater was the most consistent; Eversweet and Phoenicia showed higher year sensitivity. These patterns align with the significant cultivar×year interaction.

Protocol considerations.

'Hardness' (2022–23) vs 'Texture' (2024) were pooled under a single attribute; wording may shift scale-use slightly but the net effect was modest and positive. In 2024, panelists were permitted to discuss during tasting, which may influence dispersion or central tendency. Lack of PanelistID precludes within-panelist reliability estimates.

Study context & limitations (for Methods)

- Years: Nov 3, 5, 10, 23 (2022); Oct 31 (2023); Nov (2024).
- Participants: 85 (2022), 101 (2023), 148 (2024) public volunteers; blind tastings in 2022–23; discussion allowed in 2024.
- Cultivars: Chater, Eversweet, Phoenicia, Wonderful.
- Attributes: 2022–23: aril_color, tartness/acidity, seed_hardness, sweetness, overall; 2024: aril_color, tartness/acidity, seed_texture, sweetness, overall (hardness/texture pooled).
- No PanelistID; limits mixed-effects modeling and within-panelist precision.
- Environmental factors (rain/heat) hypothesized but not modeled; consider linkage with field records in future work.

Table 1. One-way ANOVA for Overall by Variety

Effect	df	F	p	Eta^2
Variety	3	19.26	3.18e-12	0.042

Table 1: Shows that there is a highly significant difference between cultivar means, especially between Chater & Wonderful and Eversweet & Phoenicia.

Table 2. One-way ANOVA for Overall by Year

Effect	df	F	p	Eta^2
Year	2	9.92	5.28e-05	0.015

Table 2: Shows slight difference in means by year.

Table 3. Two-way ANOVA (Variety × Year) for Overall

Effect	df	F	p
C(Variety)	3.0	19.72	1.68e-12

C(Year_str)	2.0	10.25	3.85e-05
C(Variety):C(Year_str)	6.0	5.35	1.83e-05
Residual	1298.0	nan	nan

Table 3: Shows that there is a high cultivar effect, year effects present but not as effective. Eversweet and Phoenicia vary more by year, Chater and Wonderful are more consistent.

Table 4. Multiple Linear Regression predicting Overall (standardized predictors)

Term	Beta (std)	SE	t	p
Intercept	6.237	0.041	151.64	0.0000
Sweetness	1.015	0.043	23.89	0.0000
Acidity	0.05	0.042	1.19	0.2351
Color	0.379	0.043	8.82	0.0000
Texture	0.148	0.043	3.4	0.0007

Table 4: Shows that sweetness was the strongest factor for consumers, having the strongest association with the overall score. Followed by color, texture, and acidity.

Table 5. Variance Inflation Factors (VIF)

Variable	VIF
const	1.0
Sweetness	1.068
Acidity	1.04
Color	1.09
Texture	1.112

Table 5: Shows that each characteristic contributes meaningful information.

Table 6. Correlation matrix (Sweetness, Acidity, Color, Texture, Overall)

	Sweetness	Acidity	Color	Texture	Overall

Sweetness	1.0	0.12	0.16	0.16	0.58
Acidity	0.12	1.0	-0.03	-0.13	0.07
Color	0.16	-0.03	1.0	0.26	0.31
Texture	0.16	-0.13	0.26	1.0	0.21
Overall	0.58	0.07	0.31	0.21	1.0

Table 6: Shows that sweetness was the strongest factor for consumers, having the largest correlation score with the overall. Followed by color, texture, and acidity.

Table 7. Sample size per Year × Variety

Year	Chater	Eversweet	Phoenicia	Wonderful
2022	84	83	83	83
2023	101	101	100	100
2024	147	142	140	146

Table 7: Shows sample size by year.

Pairwise cultivar differences (Overall)

Tukey HSD tests compare all cultivar pairs with family-wise error control (α=0.05). The compact letter display groups cultivars that are not significantly different; cultivars sharing a letter belong to the same statistical group.

Table 8. Overall means (±SD), N, and compact letter groups by cultivar

Cultivar	Mean	SD	N	Group
Chater	6.68	1.66	332	A
Wonderful	6.57	1.76	329	A
Eversweet	5.85	2.15	326	B
Phoenicia	5.84	1.86	323	B

Table 8: Shows that Chater had the highest overall mean, closely followed by Wonderful. The two lowest were Eversweet and Phoenicia.

Table 9. Tukey HSD pairwise comparisons for Overall by cultivar (mean diff, 95% CI, p-adj, reject)

group1	group2	meandiff	p-adj	lower	upper	reject
Chater	Eversweet	-0.831	0.0	-1.205	-0.4571	True
Chater	Phoenicia	-0.8417	0.0	-1.2166	-0.4669	True
Eversweet	Wonderful	0.7157	0.0	0.3408	1.0905	True
Phoenicia	Wonderful	0.7263	0.0	0.3507	1.102	True
Chater	Wonderful	-0.1154	0.8565	-0.4885	0.2577	False
Eversweet	Phoenicia	-0.0107	0.9999	-0.3872	0.3659	False

Table 9: Shows that Chater and Wonderful had no significant difference, and Eversweet and Phoenicia had no significant difference. All other combinations of pairs showed significant differences.

Figures

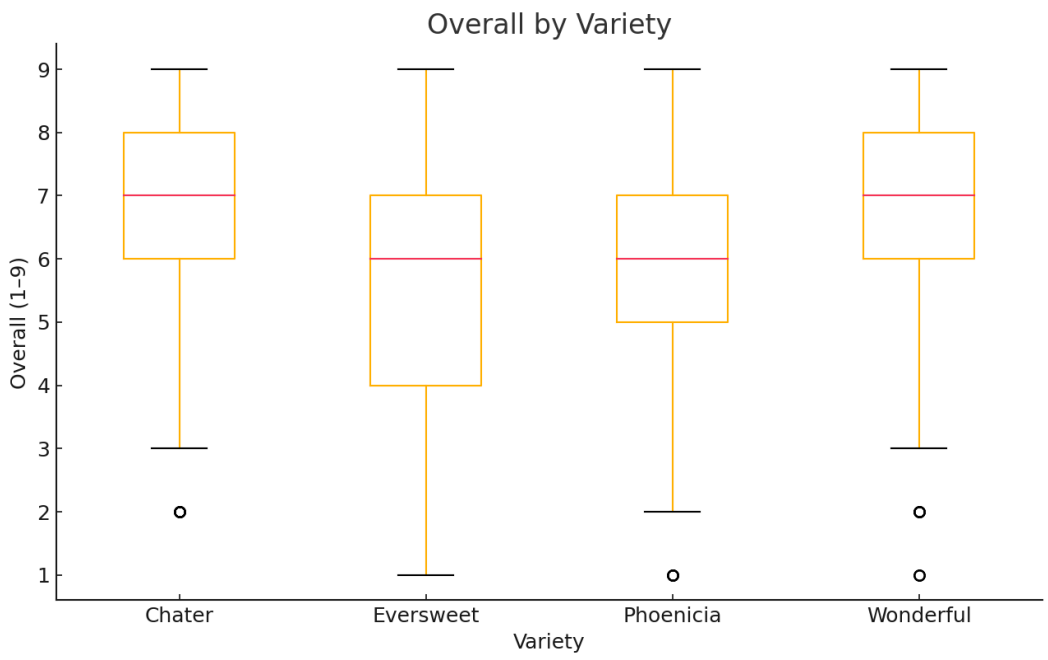


Figure 1. Overall liking by cultivar (boxplot). One-way ANOVA significant; Chater and Wonderful > Eversweet and Phoenicia.

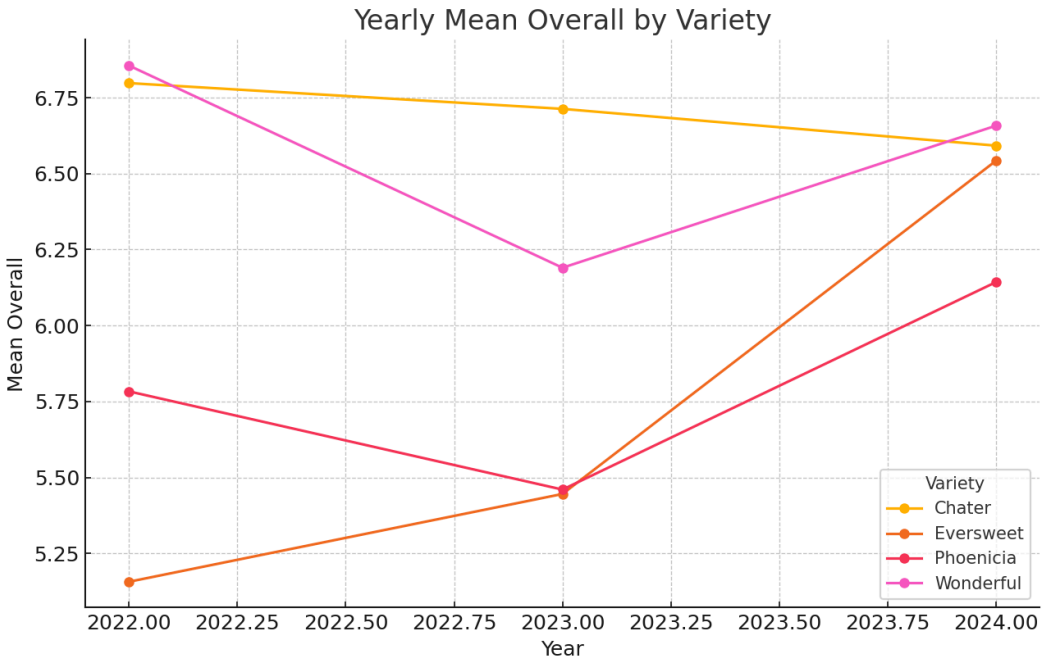


Figure 2. Yearly mean Overall by cultivar. Year effect significant; small shifts across years.

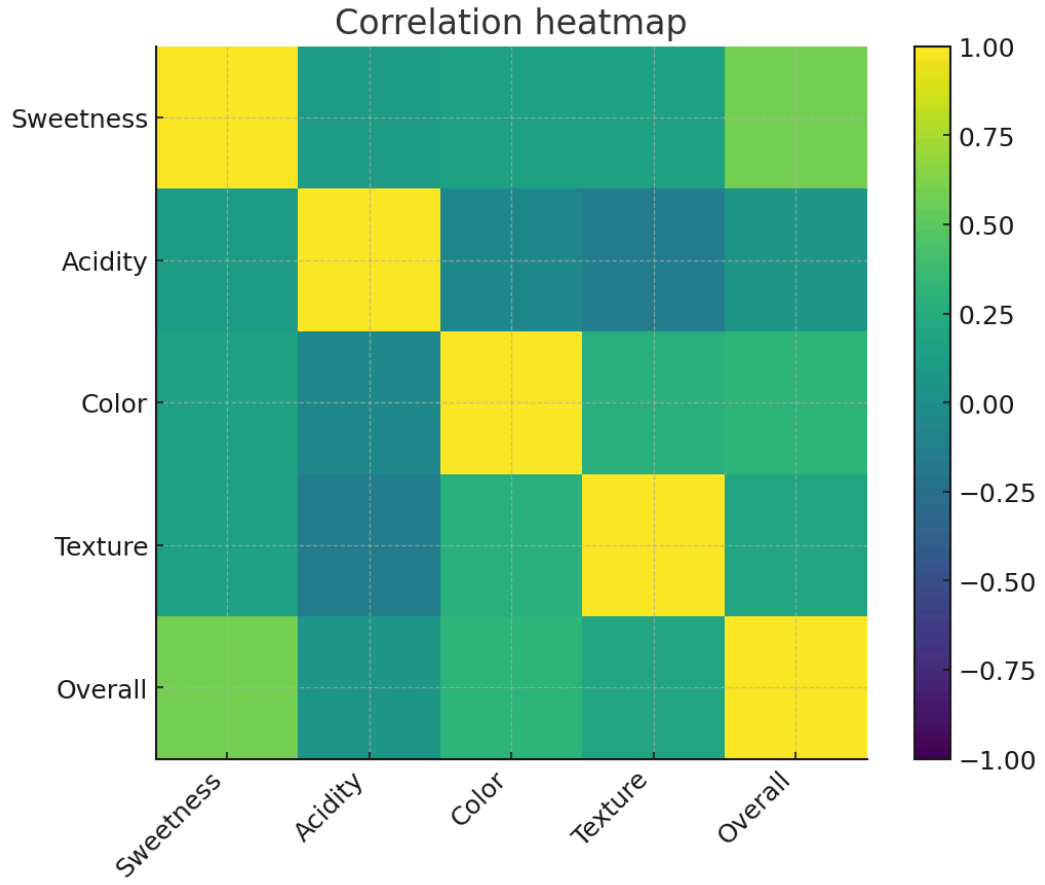
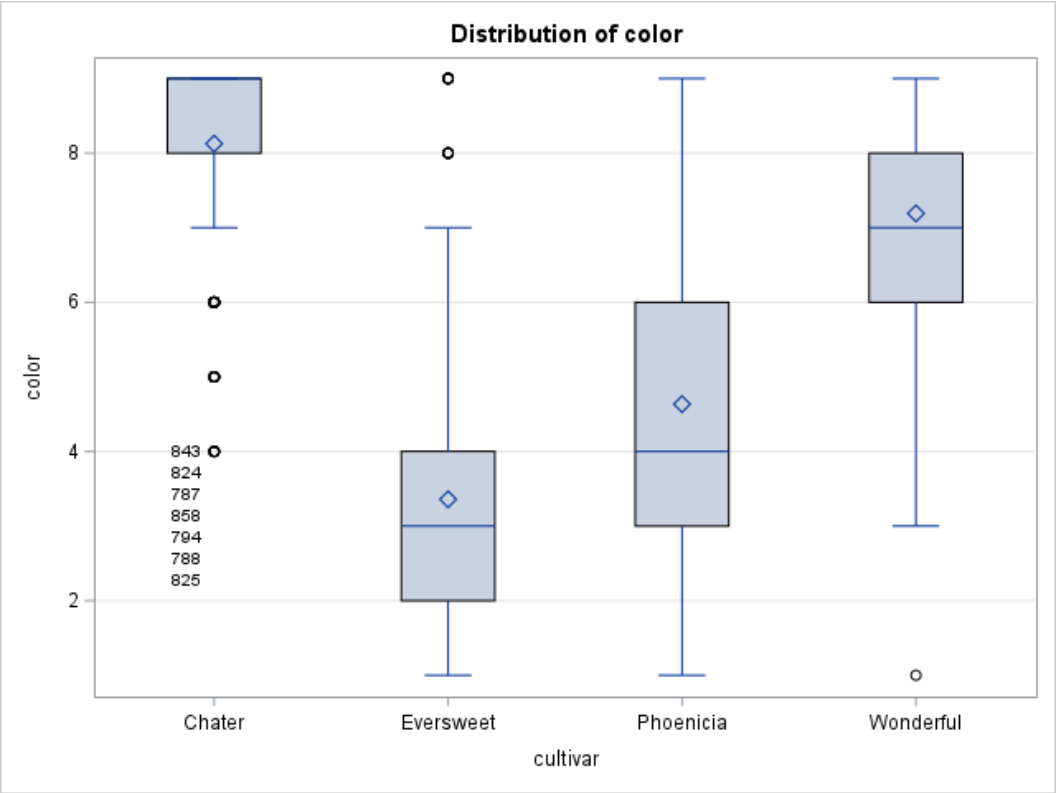
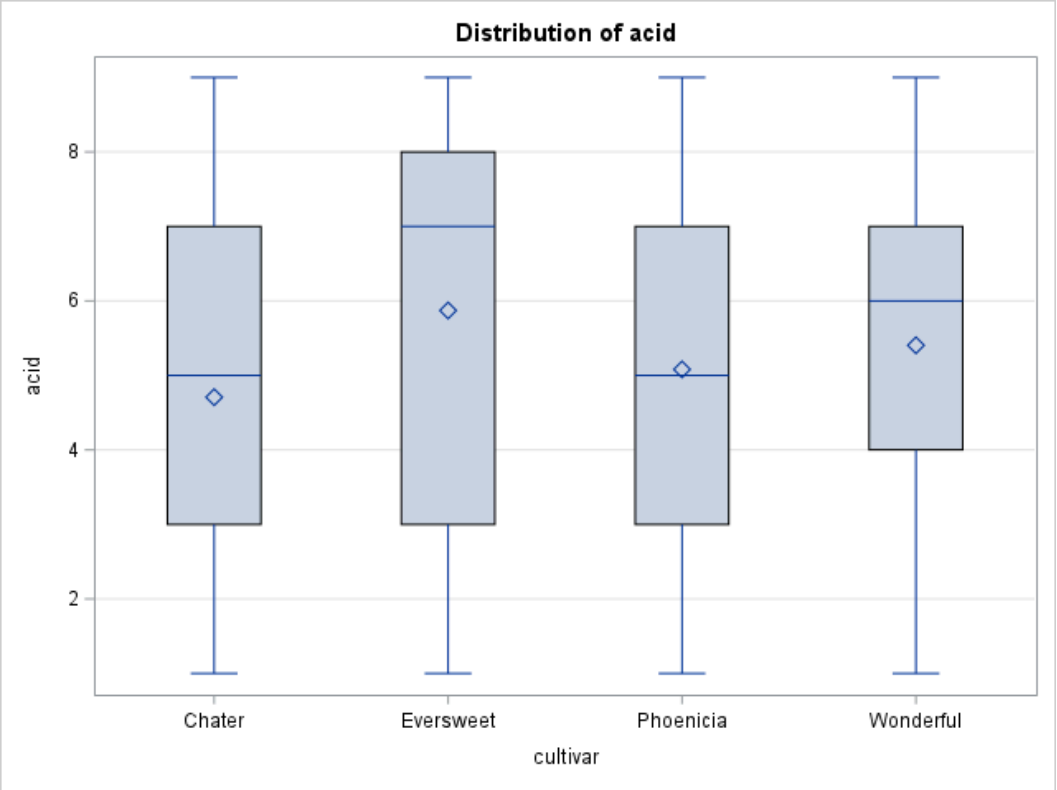


Figure 3. Attribute–Overall correlation heat map. Sweetness strongest; Color/Texture moderate; Acidity weak.

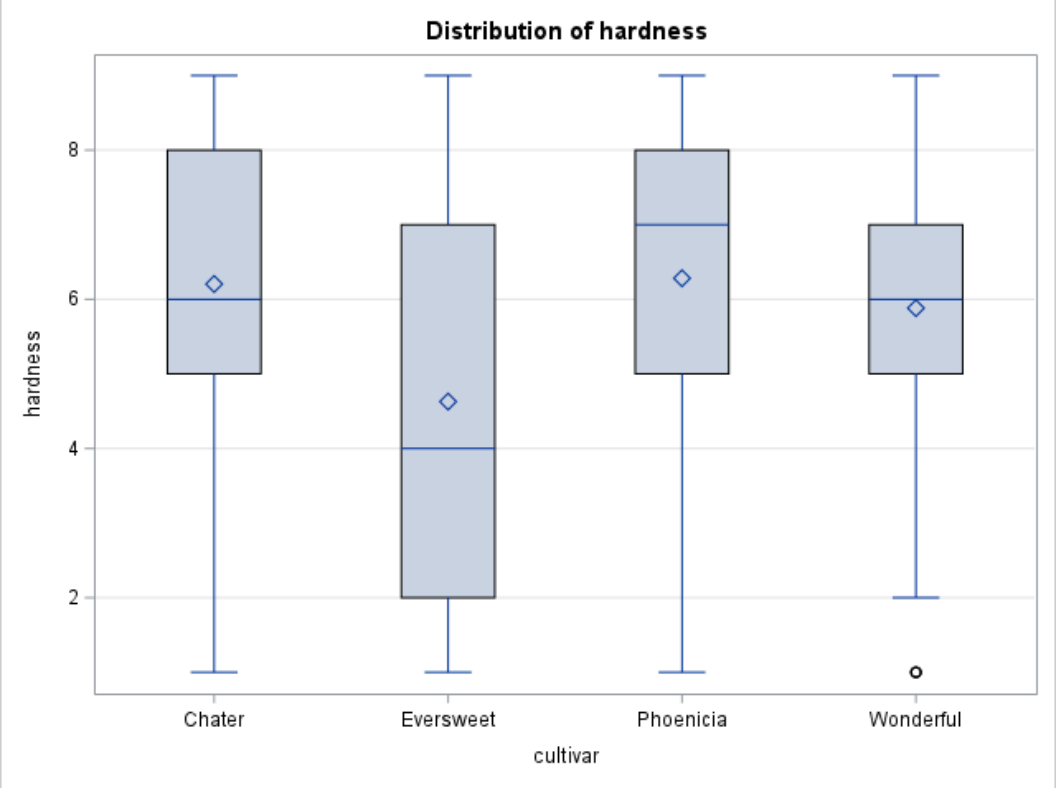
Supplementary Figures (JMP)



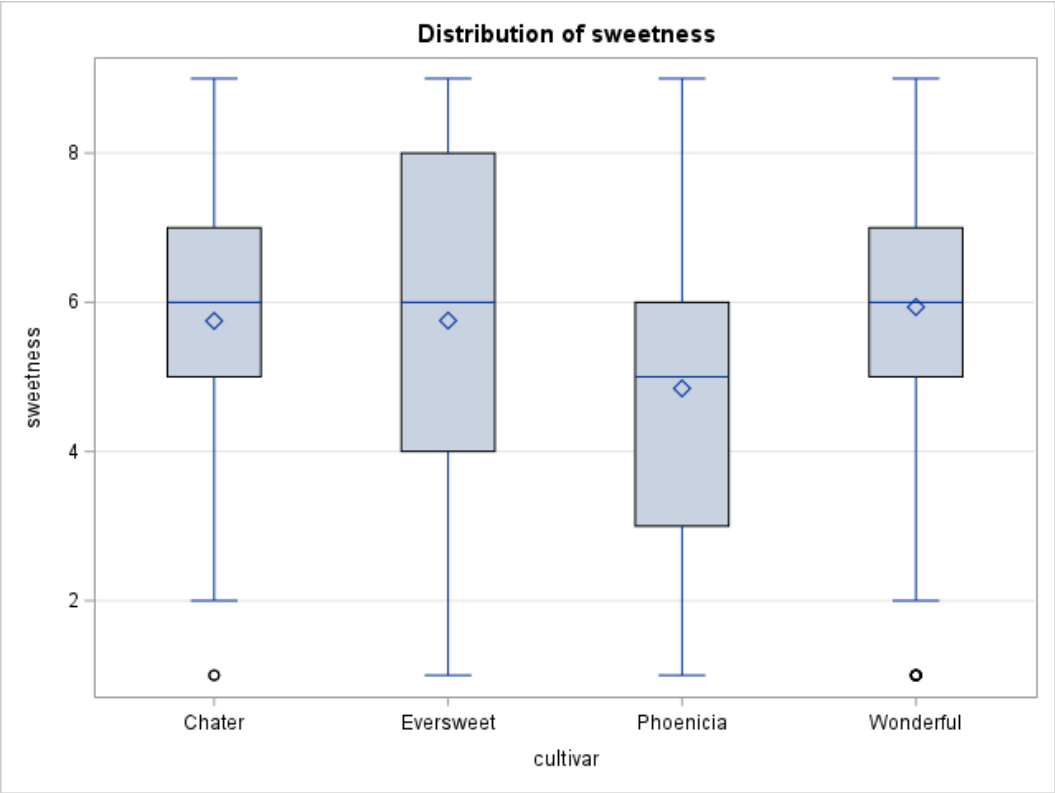
S1. Distribution of color by cultivar (boxplot).



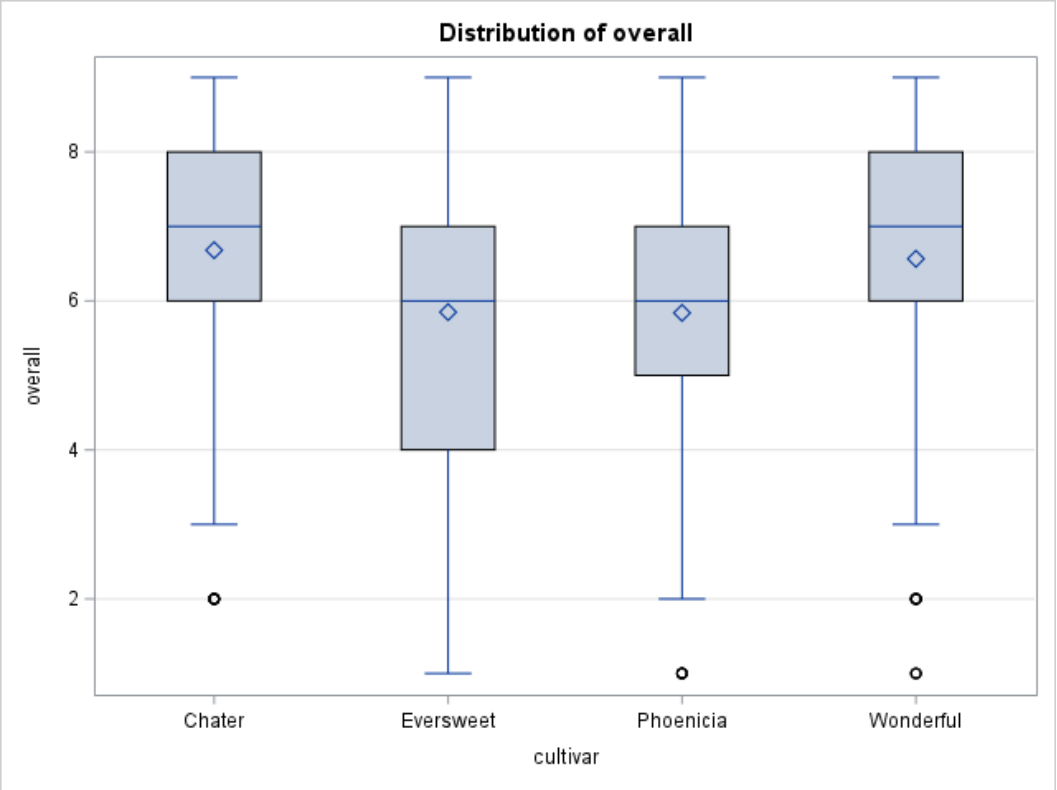
S2. Distribution of acid by cultivar (boxplot).



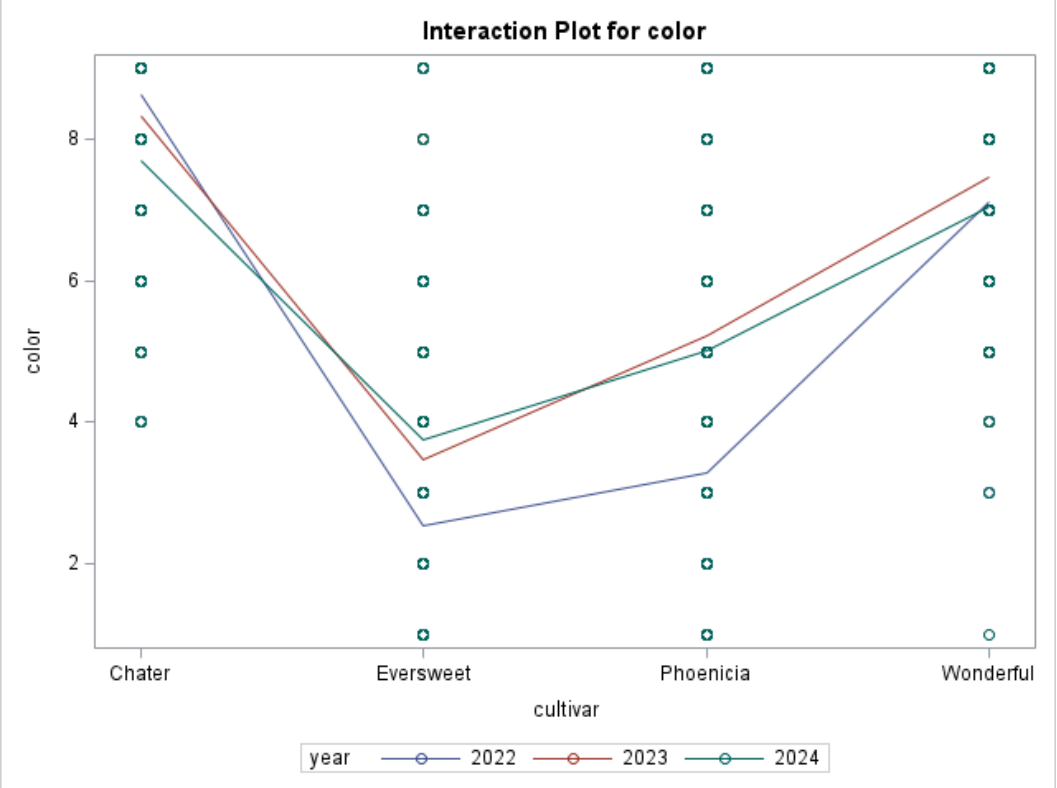
S3. Distribution of hardness by cultivar (boxplot).



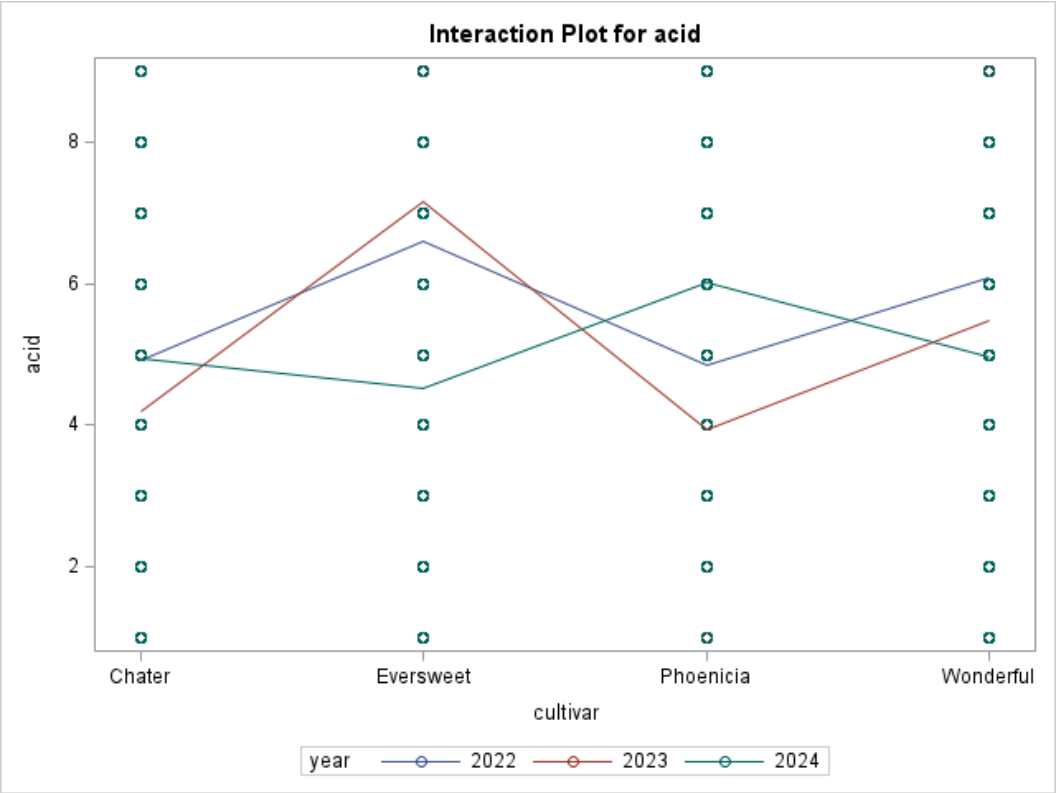
S4. Distribution of sweetness by cultivar (boxplot).



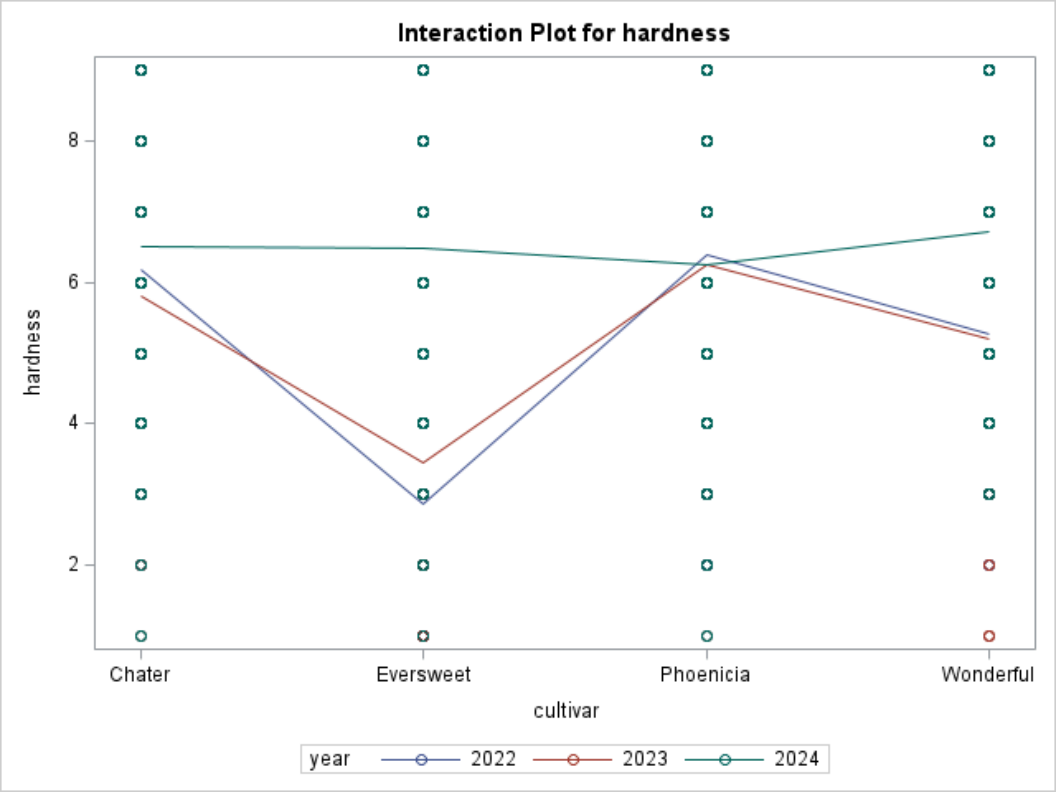
S5. Distribution of overall by cultivar (boxplot).



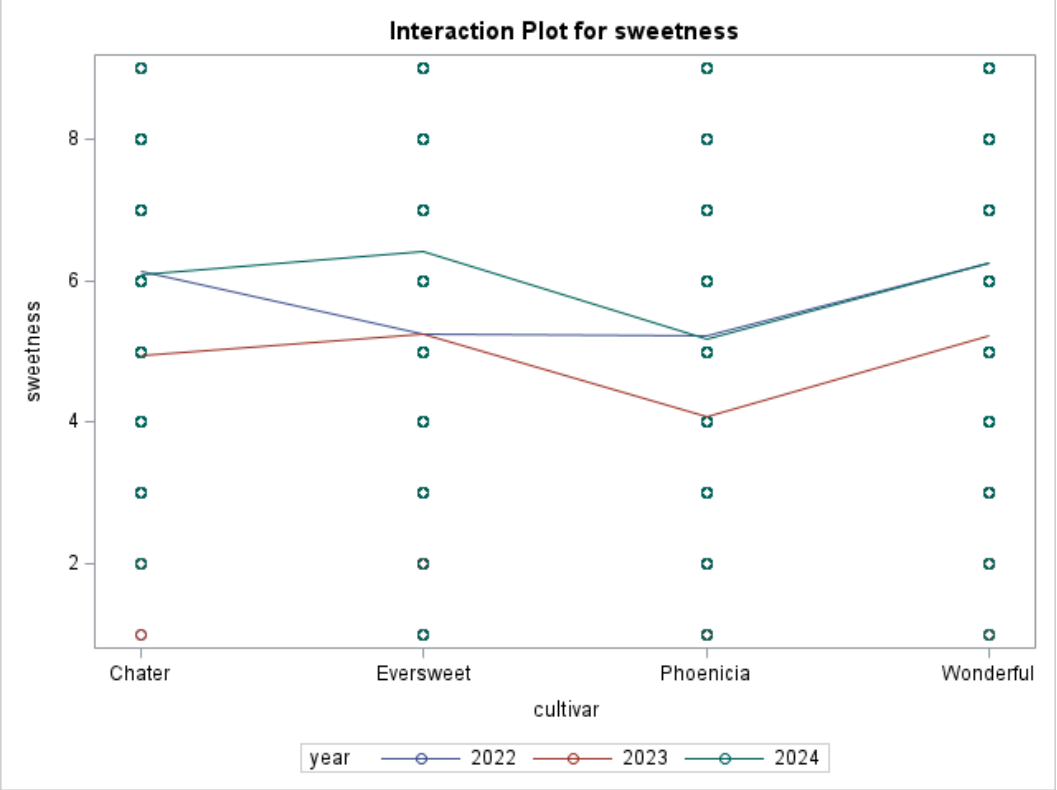
S6. Interaction plot—color by cultivar × year.



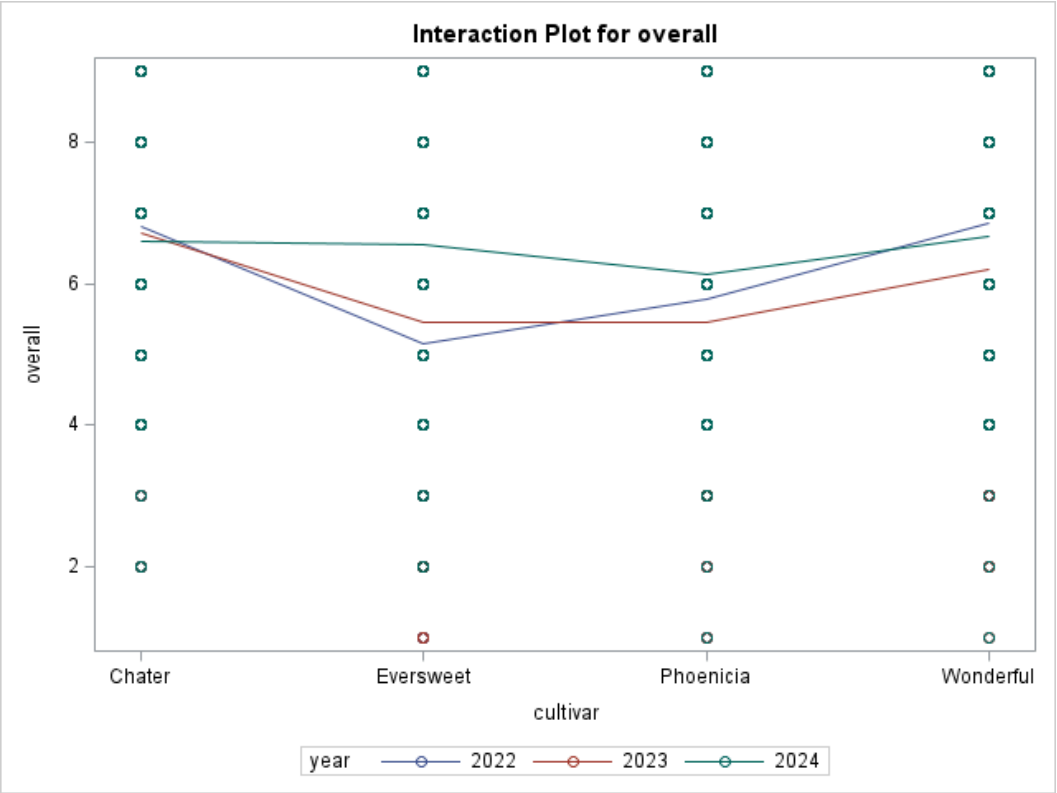
S7. Interaction plot—acid by cultivar × year.



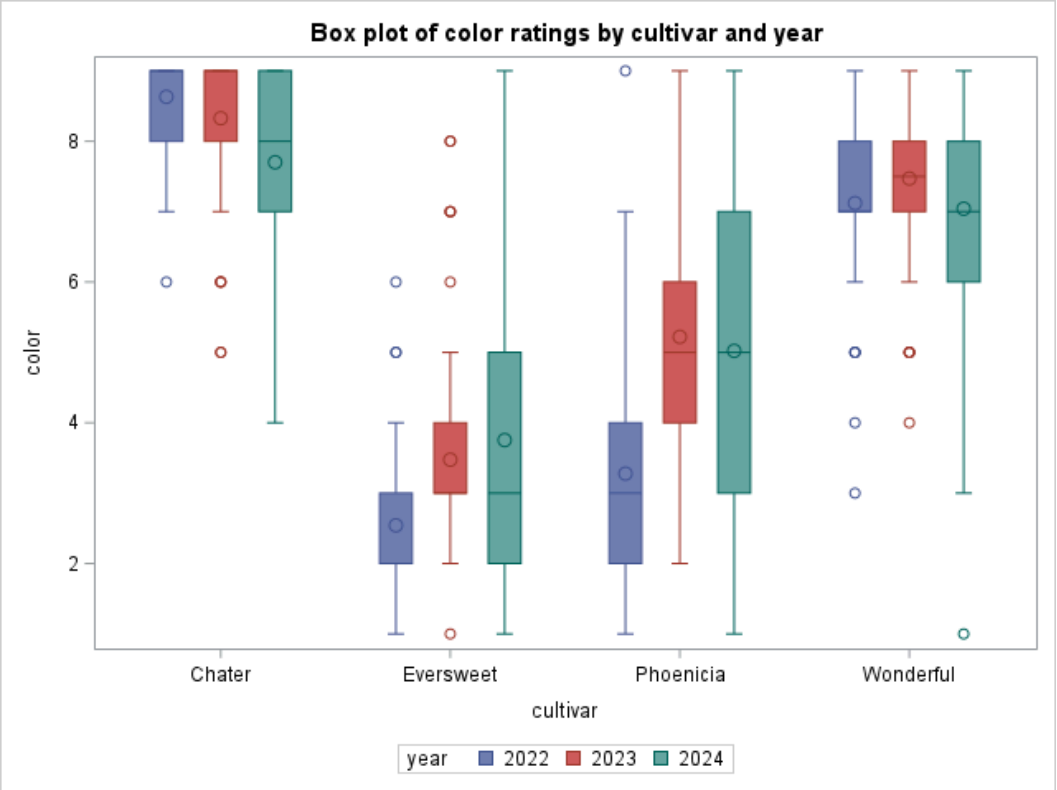
S8. Interaction plot—hardness by cultivar × year.



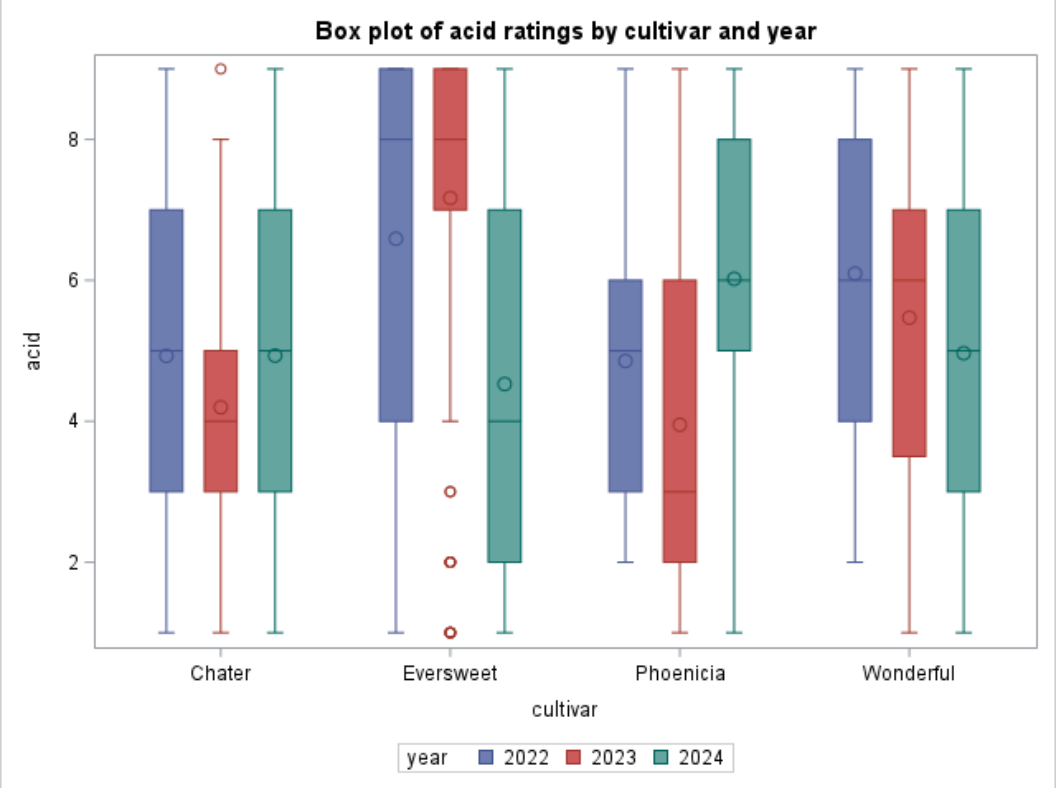
S9. Interaction plot—sweetness by cultivar × year.



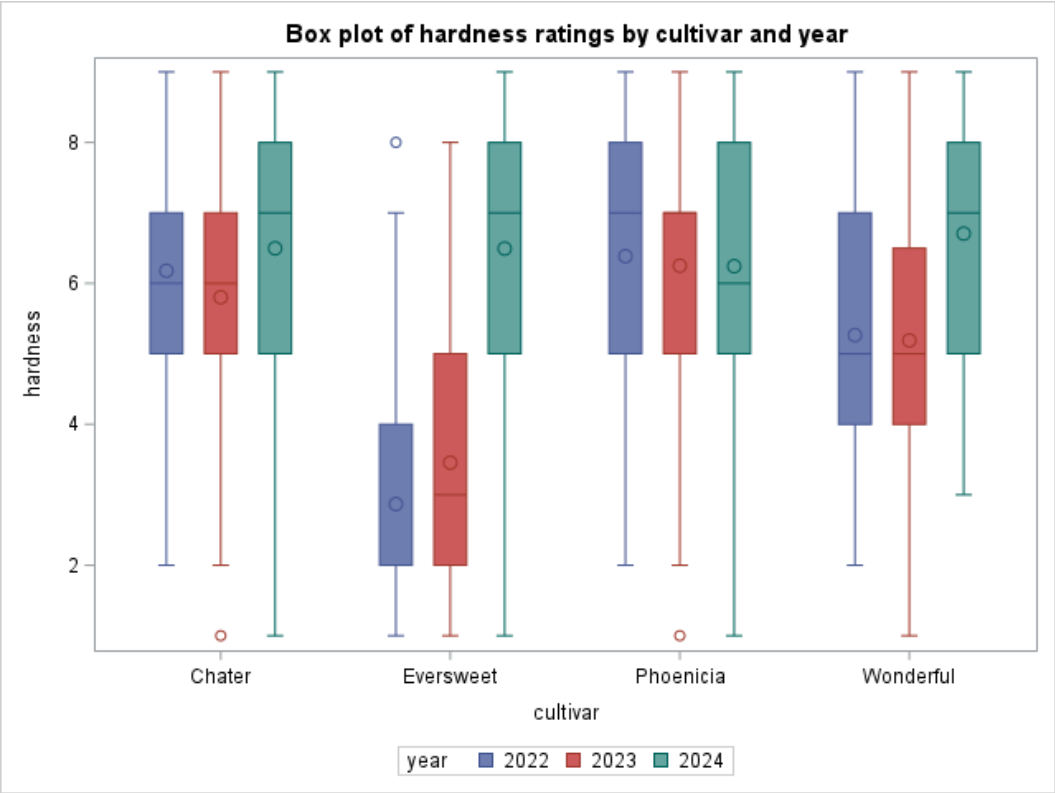
S10. Interaction plot—overall by cultivar × year.



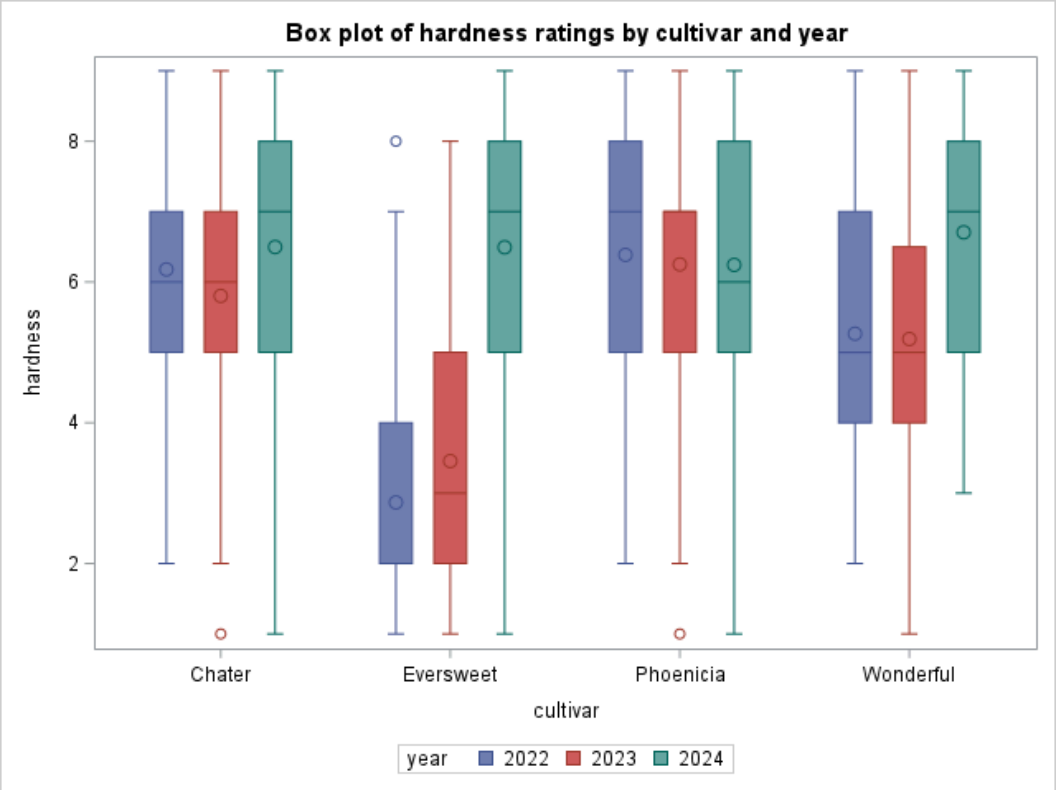
S11. Color by cultivar and year (boxplots).



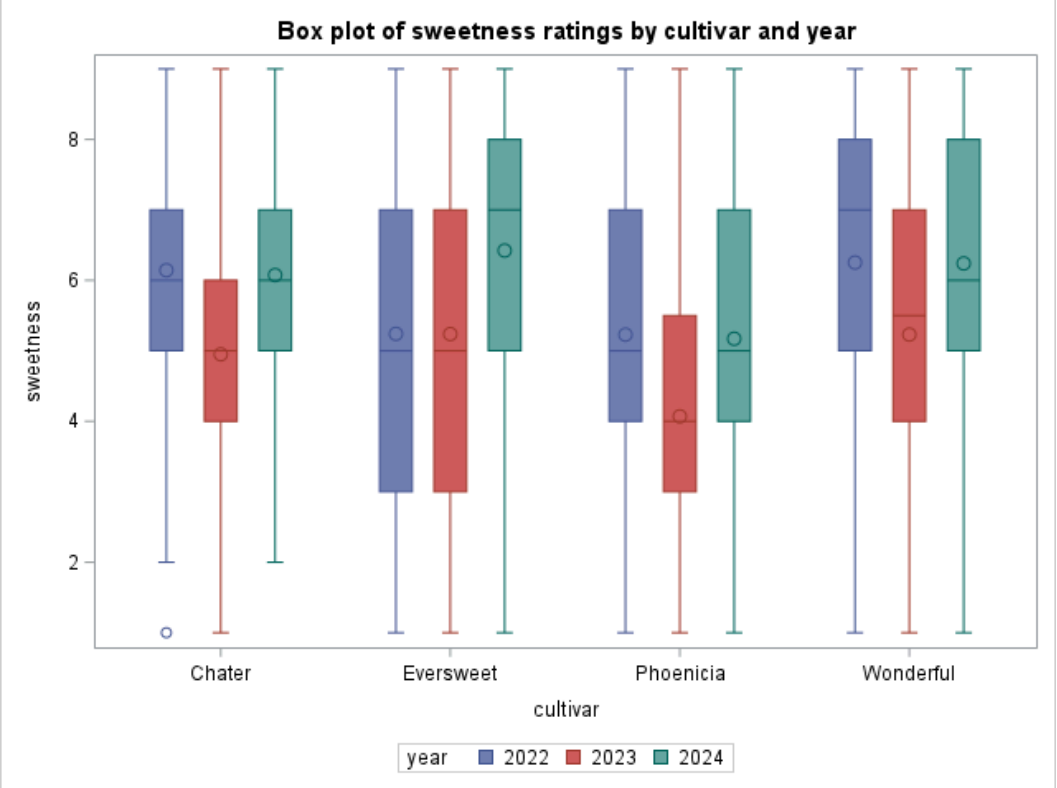
S12. Acidity by cultivar and year (boxplots).



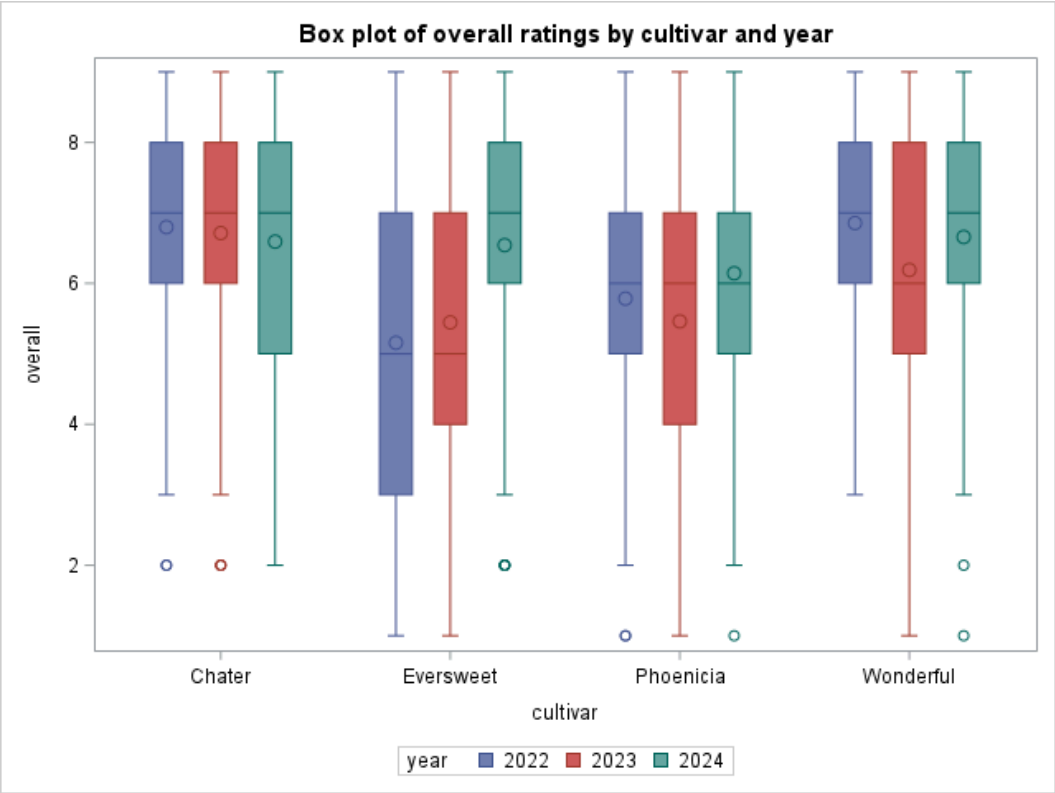
S13. Texture/Hardness by cultivar and year—set A (boxplots).



S14. Texture/Hardness by cultivar and year—set B (boxplots).



S15. Sweetness by cultivar and year (boxplots).



S16. Overall by cultivar and year (boxplots).