

Marco STEFANINI¹, Pietro ANTONINI¹, Nicola DALL'AGNOL¹, Cinzia DORIGATTI¹, Giulia BETTA¹, Silvano CLEMENTI¹, Alessandra ZATELLI¹, Monica DALLASERRA¹, Daniela NICOLINI¹, Paola BETTINELLI¹, Luca ZULINI¹, Silvia VEZZULLI¹

¹ Research and Innovation Centre, Fondazione Edmund Mach (FEM), San Michele all'Adige, Italy

Introduction

The global viticulture is currently facing challenges imposed by climate change. In mountain viticulture contexts, these critical issues are exacerbated by rising average temperatures and increasing irregularity in atmospheric events. These factors place significant pressure on currently cultivated varieties exposing them to accelerated ripening and a progressive imbalance in their acid profile. The breeding program focused on generating progeny from Chardonnay and Schiava to facilitate vineyard management in challenging orographic conditions and to select for diverse vegetative cycles adaptable to various altitudes and latitudes.

Materials & Methods

A crossbreeding plan was initiated using *V. vinifera* cvs. Chardonnay and Schiava as parents, crossed with a resistant genotypes (F12P161, 9-16-06, SV 12375). The donor parent carries multiple resistance loci: RPV1, RPV3-1, and RPV12 (downy mildew) and RUN1, REN3, and REN9 (powdery mildew). The resulting seeds were germinated and the seedlings underwent the controlled phenotypic screening via artificial inoculation with *P. viticola* and *E. necator*, and the Marker-Assisted Selection to confirm the pyramiding of resistance genes. Following field establishment in 2018, further agronomic and qualitative characterization narrowed the selection together with the micro-vinification trials.



Table 1: Summary of seedling numbers across four evaluation stages, showing the reduction from 804 initial seedlings to 3 final selections.

Cross	Seedlings	Resistant Seedlings	Selected Genotypes	Vinified Genotypes	Selected for registration
Chardonnay x 9-16-6	11	4	1		
Chardonnay x F12 P161	270	87	26	9	2
Schiava x F12 P161	169	50	15	8	4
Schiava x SV12375	354	116	31	1	1
			37		
			2		
Total	804	257	120	14	3
Percentage	100	32	15	2	0.3

Genotypes under evaluation

Initial screening identified 91 promising Chardonnay-derived genotypes and 166 Schiava-derived genotypes. Following field establishment in 2018, further agronomic and qualitative characterization narrowed the selection to 9 Chardonnay and 5 Schiava genotypes. After multi-year micro-vinification trials, three elite genotypes (2 Chardonnay-type and 1 Schiava-type) were selected for official registration in the National Register of Grape Varieties (Table 1). Hybridization results in a wide genetic variability, yielding genotypes that both deviate from and are comparable to the *Vitis vinifera* parent. Agronomic and oenological assessments allow for the selection of genotypes adapted to diverse pedoclimatic conditions and market demands. These new resistant varieties represent a significant advancement for mountain viticulture, offering sustainable solutions for vineyards in extreme environments. By integrating resistance with adaptable phenological profiles, these genotypes reduce chemical inputs and simplify management while maintaining the high-quality standards associated with their parental lineages.

Table 2: Evaluation of agronomic traits and productivity across the Chardonnay derived genotypes

Genotype	Fertility	Cluster Weight (g)	Plant Production (g)	Production x ha (t)
-54	1,74	281	5140	30.84
-56	1,44	114	1442	8.65
-63	1,34	199	1987	11.92
-114	1,57	178	2433	14.60
-139	1,00	113	430	2.58
-140	1,89	139	2432	14.59
-150	1,70	154	2615	15.69
-152	2,18	245	4867	29.20
-154	1,09	117	1171	7.03



Table 3: Evaluation of agronomic traits and productivity across the selected genotypes of the Schiava derived genotypes

Genotype	Fertility	Cluster Weight (g)	Plant Production (g)	Production x ha (t)
13	1.87	191	3833	23.00
33	1.71	338	3731	22.39
41	1.89	169	2867	17.20
59	1.87	310	5333	32.00
194	1.81	215	3550	21.30

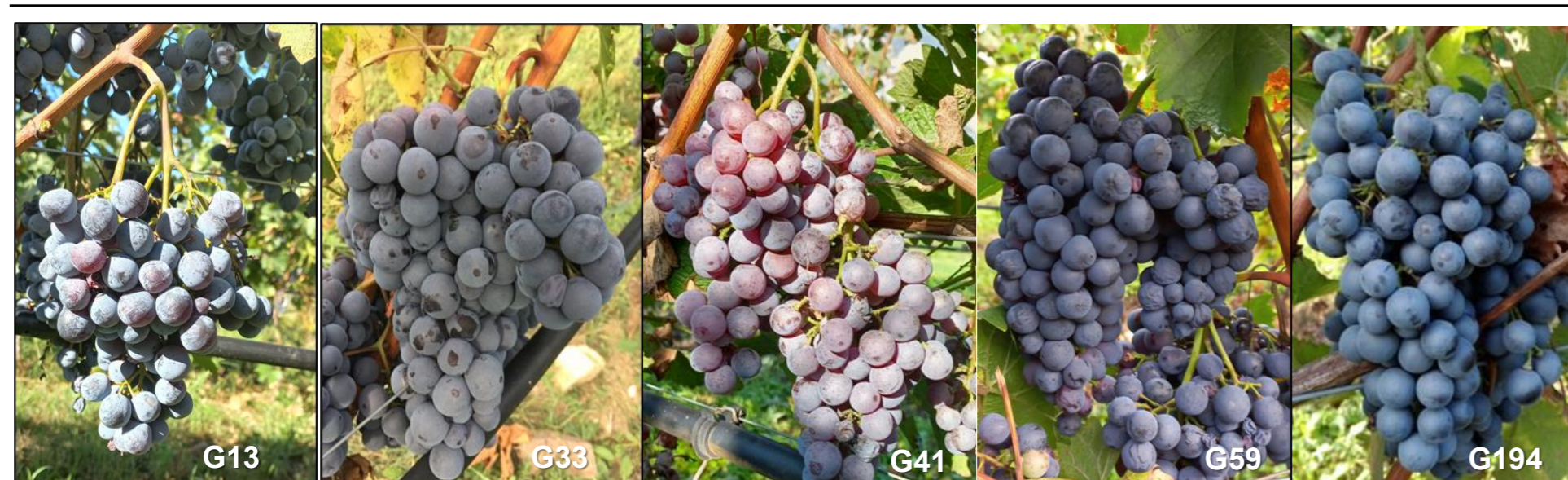


Figure 1: Phenological variability and vegetative cycle duration across the Chardonnay derived genotypes.

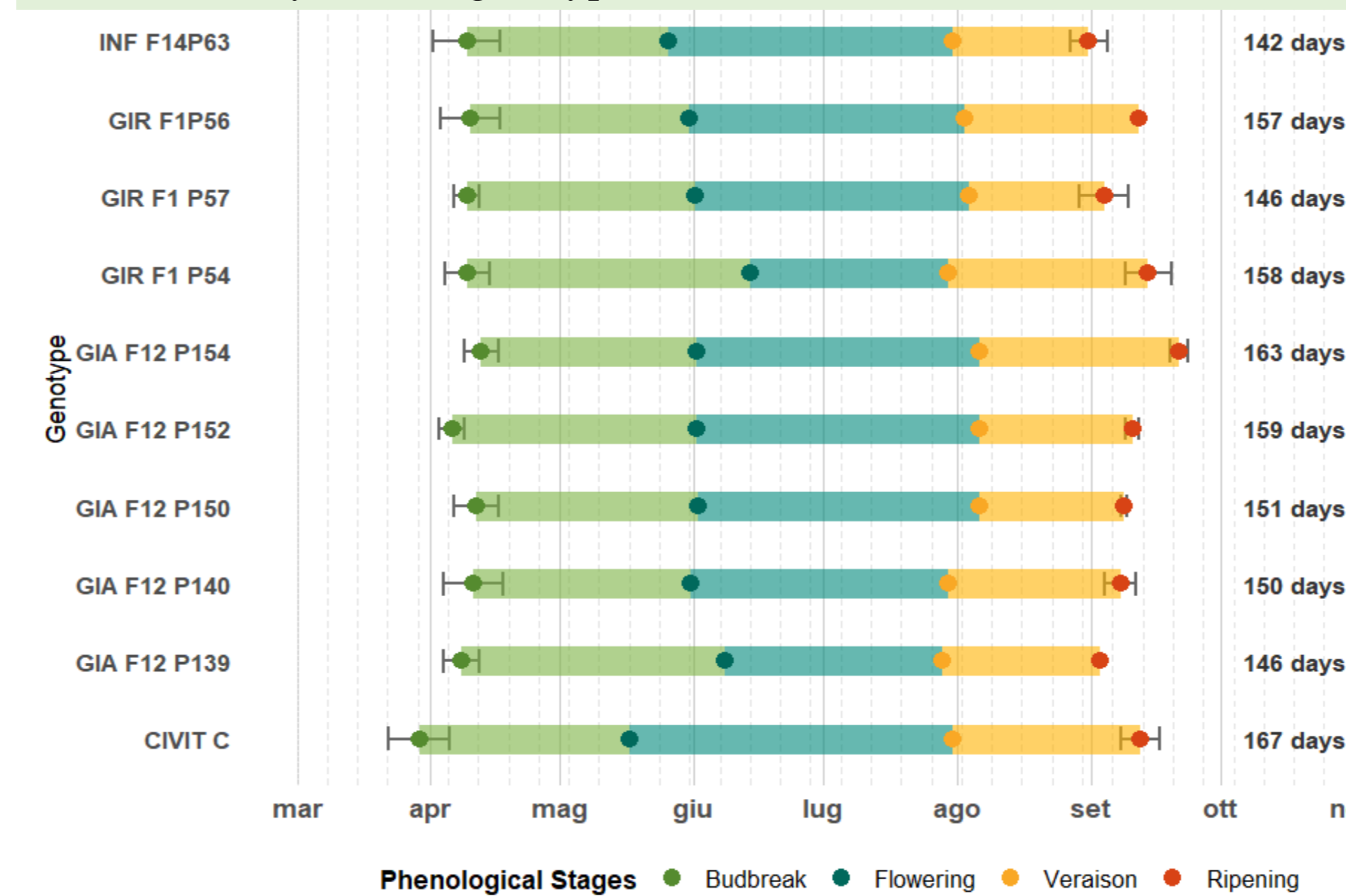


Figure 3: Harvest timing of the Chardonnay derived genotypes compared to the parental control

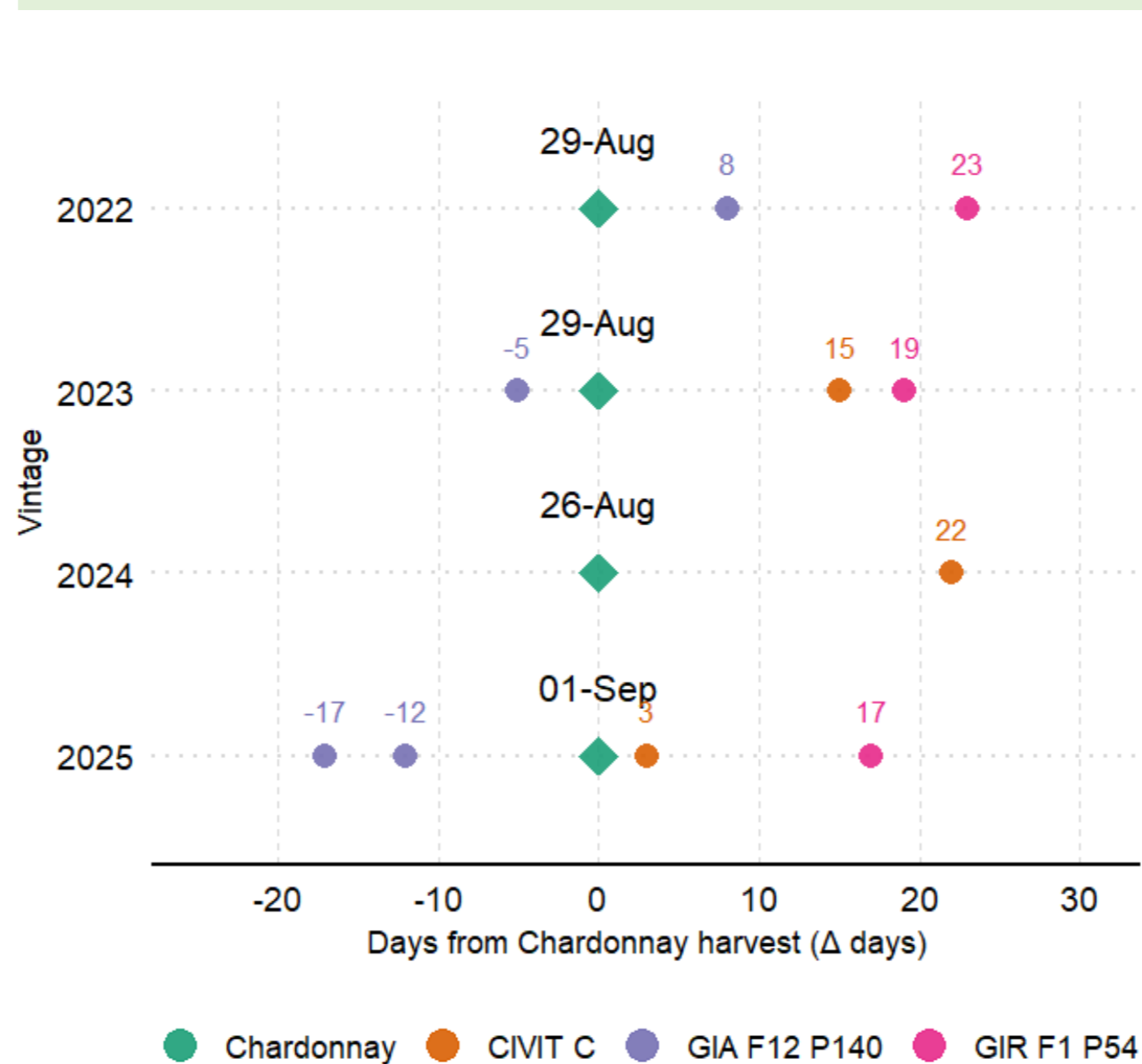


Figure 5: Phenological variability and cycle duration across the Schiava derived genotypes.

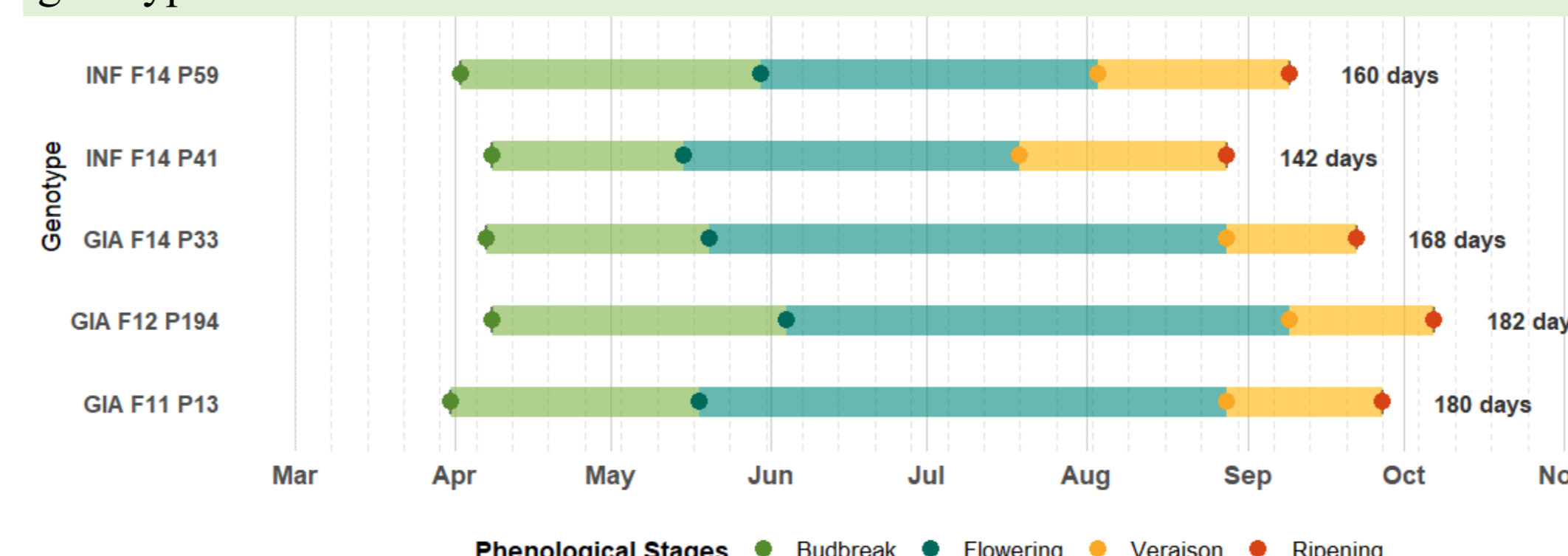


Figure 2: Acidic profile of the Chardonnay derived genotypes (3-year mean). Concentrations (g/L) with different letters differ significantly (p < 0.05).

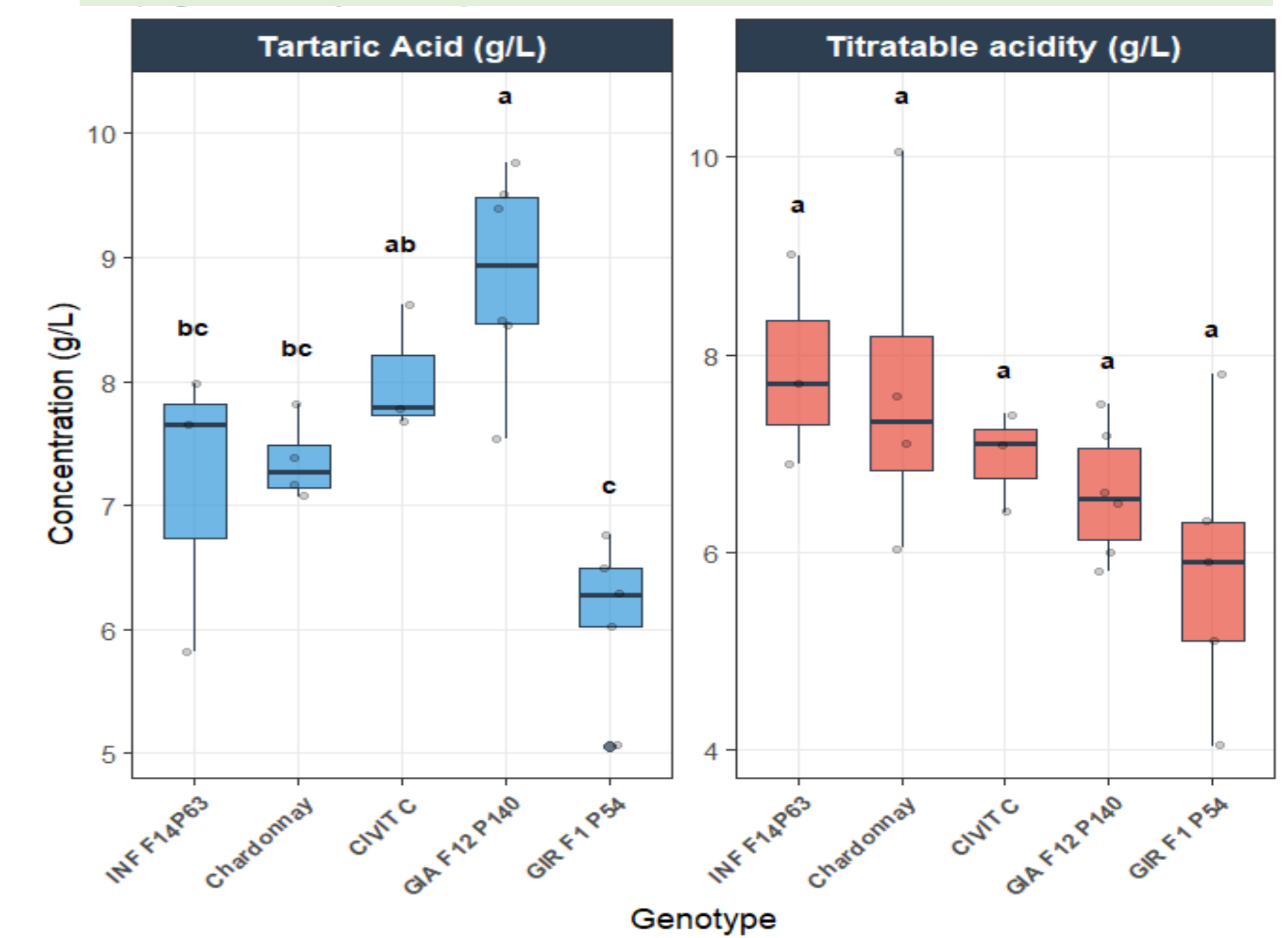


Figure 4: Relationship between Potassium (K) content and tartaric acid in the Chardonnay derived genotypes

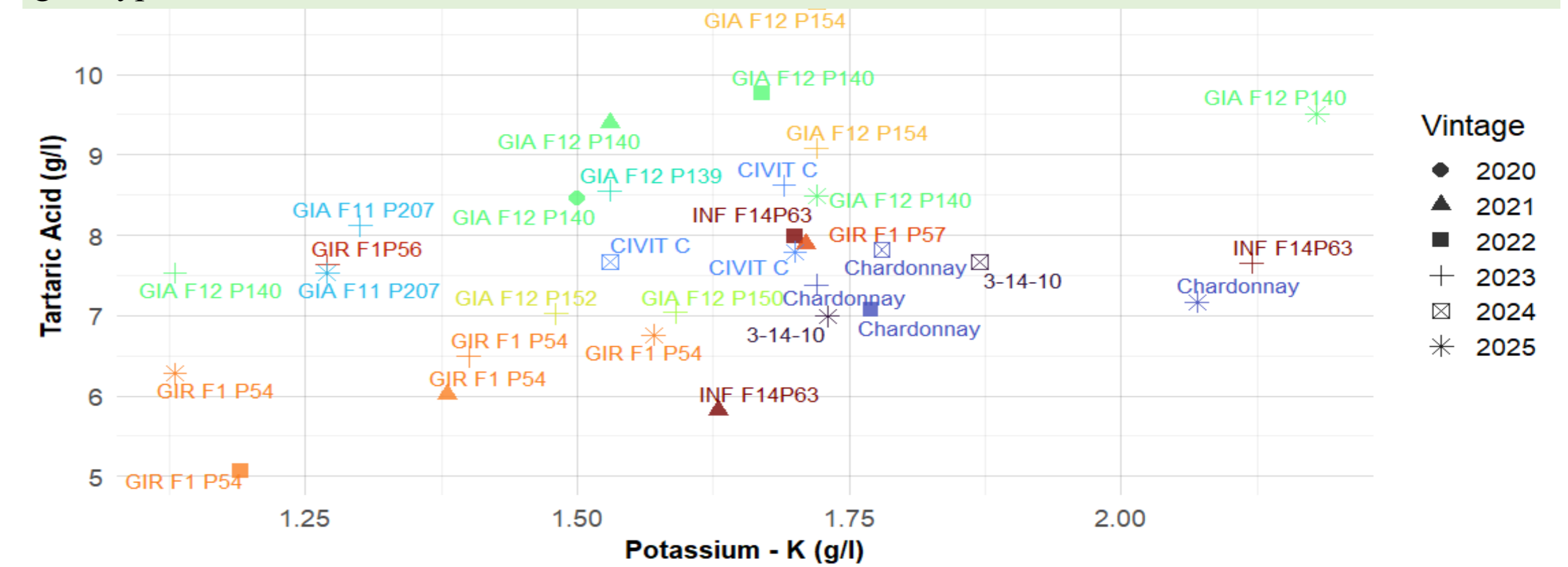


Figure 6: Sensory profiling of the Schiava derived genotypes. Bubble diameter is proportional to the perceived intensity of Red Fruit notes.

