WORLD COFFEE RESEARCH

From Perception to Pipeline

How WCR is translating quality impressions into breeding targets

Executive Summary

Coffee quality is a primary driver of consumer preference, brand identity, and commercial value in today's global industry. As overall demand grows, markets pursue increasingly differentiated products, and the climate crisis reshapes the growing environment, breeding programs face new challenges. To remain relevant and effective, breeding programs run by World Coffee Research (WCR) and those of partners in WCR's global breeding networks must develop new varieties that align with market expectations. To do this, network breeders must define, measure, and improve quality traits that matter to the industry. To establish breeding targets related to quality, a critical first step is to map industry perceptions related to quality and identify key quality drivers. Breeders can then use this input to align breeding efforts with market needs. To this end, WCR engaged its member companies to provide feedback through interviews and surveys on critical drivers of quality.

Key Insights

- **Negative traits are dealbreakers:** There is broad consensus that there are key negative attributes to be avoided for both *Coffea arabica* and *Coffea canephora* (robusta).
- **Positive traits vary by market:** Desired positive attributes—such as sweet, fruity, smooth, citrus fruit, and brown sugar—vary more across companies and market segments, signaling a need for a diverse set of variety options.
- **Origin matters:** Buyers consistently prioritized origin as important for determining flavor profiles and making sourcing decisions. Most respondents recognize the genetic influence of varieties is embedded in origin-specific flavor profiles.
- **Consistency is king:** Buyers prioritize quality consistency across crops and years, prioritizing it above novelty or rare profiles.

Conducting qualitative interviews at Tim Hortons, Ancaster, Canada

Introduction: Setting a New Course for Quality in Coffee Breeding

Defining quality traits is essential for WCR's coffee breeding program, and those of its network partners, because coffee quality is a primary driver of its commercial value and a key factor influencing consumer preference. These breeding programs must develop new varieties that align with diverse industry and consumer expectations. A thorough understanding of desirable and non-desirable coffee quality attributes as desired by roasters and buyers is essential for breeding programs entrusted with variety development to meet customer expectations. Accordingly, this consultative study generated knowledge on coffee quality perceptions to inform the development of quality-focused breeding targets and strategies. **It is the first step toward defining measurable, prioritized, quality-related traits to target in breeding, which must balance market needs and plant genetics.**

Methodology: Mapping Industry Perceptions

This process explores potential breeding targets that are measurable and actionable using a two-pronged research approach. Qualitative interviews were conducted in person with major WCR member companies across Europe and North America, and by Zoom in Asia, complemented by cupping sessions with quality teams. This approach ensured a deep, context-rich understanding of how buyers define quality, what origins they prioritize, and what attributes they value or reject. Quantitative surveys for arabica and robusta were also distributed to all WCR member companies. Developed together with sensory researcher Dr. Fabiana Carvalho and the Specialty Coffee Association, the surveys asked participants to rank the importance of key beverage characteristics (e.g., flavor, acidity, aftertaste), rate over 30 specific flavor and sensory attributes, and assess how positive or negative the attributes are. Responding companies (78 for arabica and 23 for robusta) were geographically distributed across 19 countries in Europe, Asia, and Latin America with a majority of responses from U.S. companies. Data were analyzed using statistical and multivariate methods (e.g., ANOVA, PCA) in R and JMP software.

What the Industry Values

CONSENSUS ON WHAT TO AVOID

Across markets and coffee types, companies strongly agreed on avoiding negative attributes, like off-flavors that affect product acceptance. The most important undesirable attributes for which there was shared agreement were: **moldy, potato, chemical, rough, and metallic.**

This consensus is critical for breeding, as it offers clear, shared negative targets to reduce.

VARIED VIEWS ON POSITIVE ATTRIBUTES

Perceptions of positive attributes varied by market and origin. While traits like **sweetness, fruity, floral, and brown sugar** were widely favored, there was **not total consensus**. Some companies prioritized complexity (high acidity, body, intensity), while others preferred neutral profiles. All companies valued **diversity**, which helps create distinct products and stable blends, but had differing views on preserving origin-specific traits. **Medium roasts** emerged as the best baseline for assessing quality, balancing flavor expression with defect control.

These differences underscore the need to breed new varieties that target multiple and varied end products, rather than focusing on one-size-fits-all solutions.

Figure 1. Arabica response distribution showing the positivity or negativity of specific attributes for beverage quality.

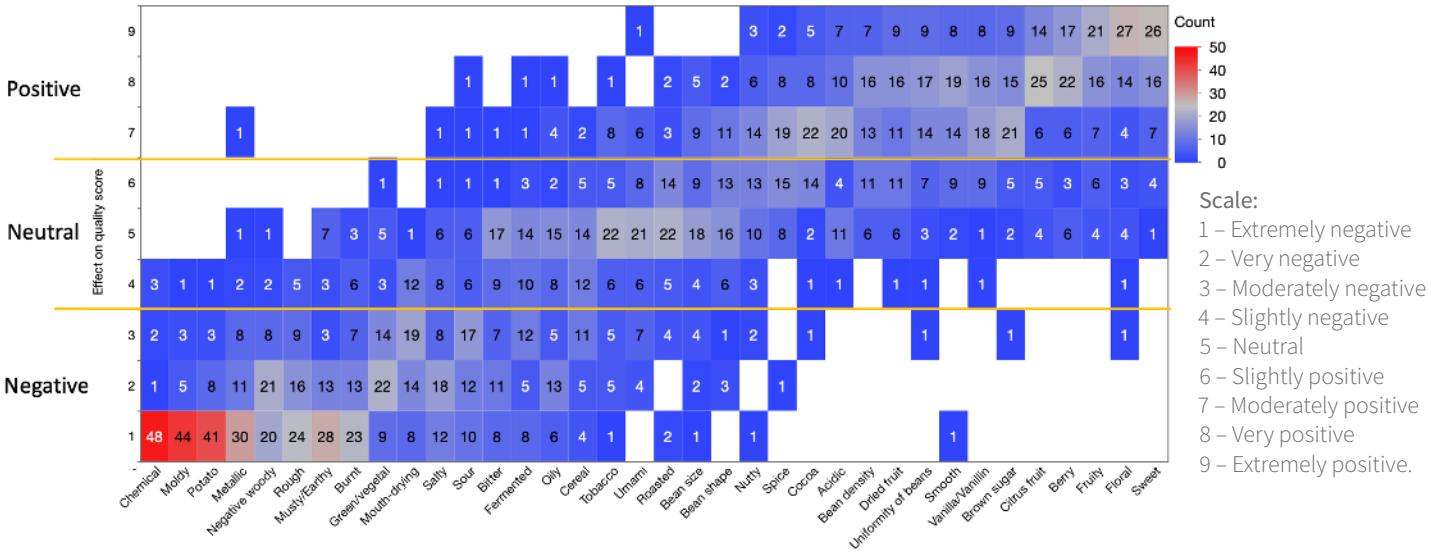
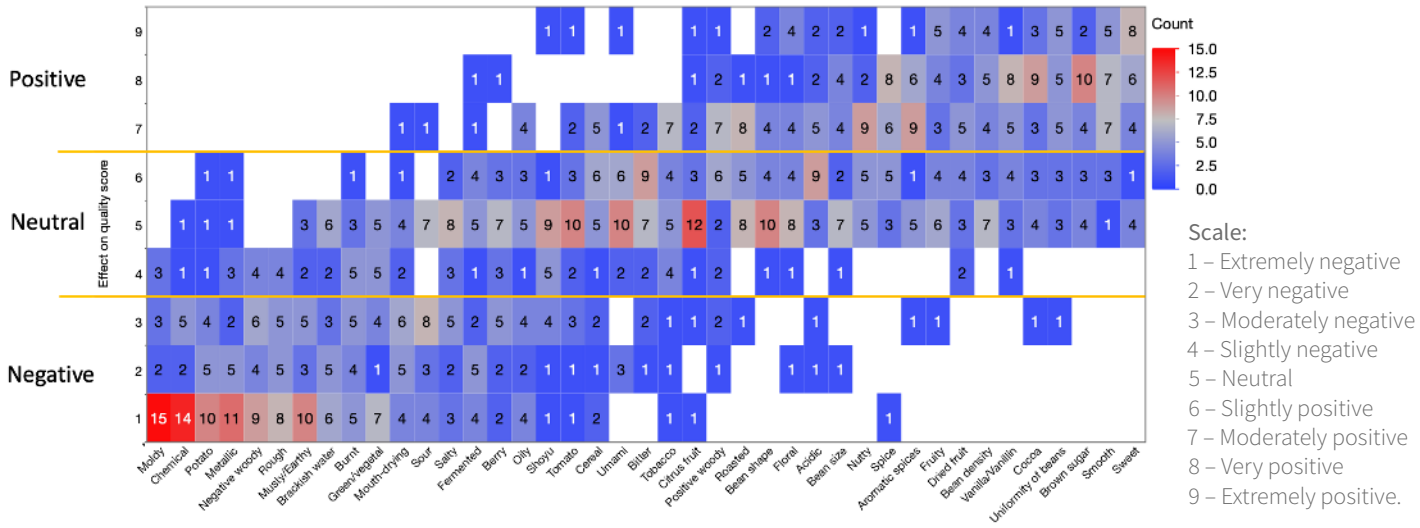


Figure 2. Robusta response distribution showing the positivity or negativity of specific attributes for beverage quality.



COMPLEXITY VS. NEUTRALITY

Many companies valued sensory complexity, generally characterized by high acidity, body, and flavor intensity, especially for coffee from certain origins. But **opinions differed**, and some respondents prioritized neutral profiles for their targeted product profiles.

ORIGINS MATTER AND CONSISTENCY IS KING

Interviewees value regional reputation and consistency over specific varieties, which are rarely labeled in commercial trade. Still, participants revealed an implicit awareness of how genetics drive origin-specific flavor—e.g., Brazil as "neutral," Kenya as more distinct. A clear industry priority is **consistency** in flavor, quality, and supply, which enables predictable blending and marketing, especially for larger buyers.

ACKNOWLEDGING TRADE-OFFS

Participants acknowledged the trade-offs between quality, price, and availability, preferring varieties that deliver excellent quality, high productivity for the farmer, and cost efficiency.

CHANGING TASTES

Some buyers cautioned against "inventing new profiles," suggesting that niche or novel coffee styles may not resonate with mainstream markets. Yet others pointed to novel flavor profiles that have gained acceptance, illustrating how quickly consumer preferences can evolve. It is a reminder that market demand can change over time, which poses challenges given that breeding timelines can span decades. This underscores the need for breeding programs to maintain and deliver **diverse options** that support farmers to respond to shifting tastes.

Table 1: Summary of key quality traits

	QUALITY TRAIT	ARABICA	ROBUSTA
QUALITATIVE	Important factors	• Consistency • Complexity • Origin/ flavour profile	• Consistency
QUANTITATIVE	Most important characteristics[1] of beverage	• Flavour • Defects • Sweetness	• Aftertaste • Mouthfeel • Uniformity
QUANTITATIVE	Most positive attributes[2]	• Sweet • Citrus fruit • Fruity • Berry • Brown sugar	• Smooth • Sweet • Brown Sugar • Vanilla/Vanillin • Aromatic spices
QUANTITATIVE	Most negative attributes[3]	• Moldy • Potato • Chemical • Negative woody • Rough	• Moldy • Rough • Chemical • Negative woody • Potato
QUANTITATIVE	Green bean attributes	• Uniformity • Density	• Uniformity
QUANTITATIVE	Most desired roasting profile	• Medium	• Medium

[1] Characteristics, such as "fragrance," or "defects" are broad descriptors, while attributes—like "floral" or "berry"—are more specific, measurable elements.

[2] "Most positive" attributes are those with the highest mean score on a scale of 1-9 (1 = highly negative and 9 = highly positive) and lowest standard deviation (e.g., where there was broad consensus among respondents)

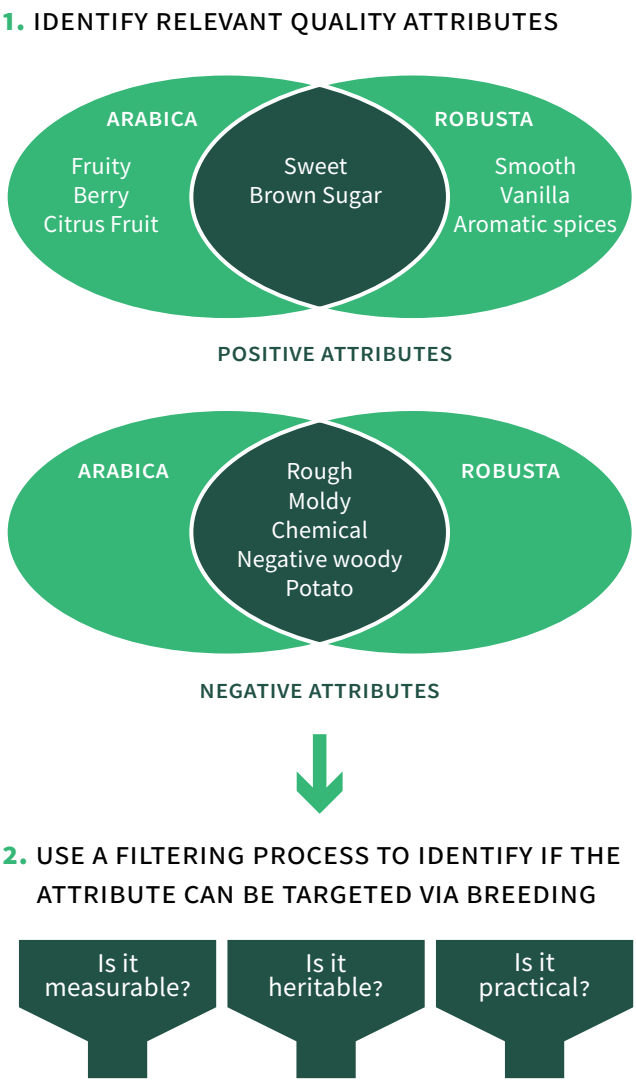
[3] "Most negative" attributes are those with the lowest mean score on a scale of 1-9 (1 = highly negative and 9 = highly positive) and lowest standard deviation (e.g., where there was broad consensus among respondents)

Visting the quality team at Lavazza, Torino, Italy.

Breeding implications: Turning insights into strategy

The report identifies both consensus and diversity in how quality is understood across the industry. It identifies several specific positive and negative attributes that could become important breeding targets. There is also some overlap between arabica and robusta (see Figure 3), which could open opportunities for efficiency in breeding programs. The much higher degree of consensus on the same set of negative attributes for both species suggests that an approach that focuses on reducing these negative attributes could be **valuable and practical**.

Figure 3. Example of how quality attributes are translated into breeding targets.



Breeding for balance

The findings from this inquiry directly inform a provisional breeding goal:

Reduce negative attributes while maintaining a diversity of positive attributes.

This statement balances two realities—**widespread alignment** on what **undermines quality**, and varied demand for different flavor expressions and sensory profiles.

The breeding program is not building a single super-variety, but a **portfolio of improved options**, each tailored to different environments and market needs. The results outlined in this report have identified some promising areas of focus and even some specific candidates for useful quality traits. Taking the next steps to actively incorporate these as targets in our breeding pipeline will require these traits to be filtered and prioritized based on four key considerations:

- **Importance:** Is it a strong driver of quality perception?
- **Measurability:** Can it be quantified through cupping, lab analysis, or instrumentation?
- **Heritability:** Is it influenced by genetics and reliably passed on?
- **Practicality:** Can it be used practically and cost-effectively across thousands of samples in breeding trials?

Using these criteria, traits like **moldy** or **potato** can be deprioritized in breeding if they are caused by storage or insect damage rather than plant genetics. Conversely, traits like sweetness or acidity, if measurable and heritable, could become prime candidates for inclusion.

The effort to translate the input gathered for this report into actionable breeding targets will take time, including improved and standardized protocols for conducting both local and centralized cuppings, enhanced in-house capacity for quality evaluation in participating breeding programs, and the development of alternative, high-throughput or analytical chemistry approaches to measure quality where cupping is impractical (e.g., where dealing with thousands of samples).

These tools, integrated with genomic selection, will enable more precise and scalable approaches for **making quality a priority breeding target.**