

Technical Working Party for Fruit Crops**TWF/57/4 Add.****Fifty-Seventh Session****Leipzig, Germany, September 7 to 10, 2026****Original:** English**Date:** September 18, 2026

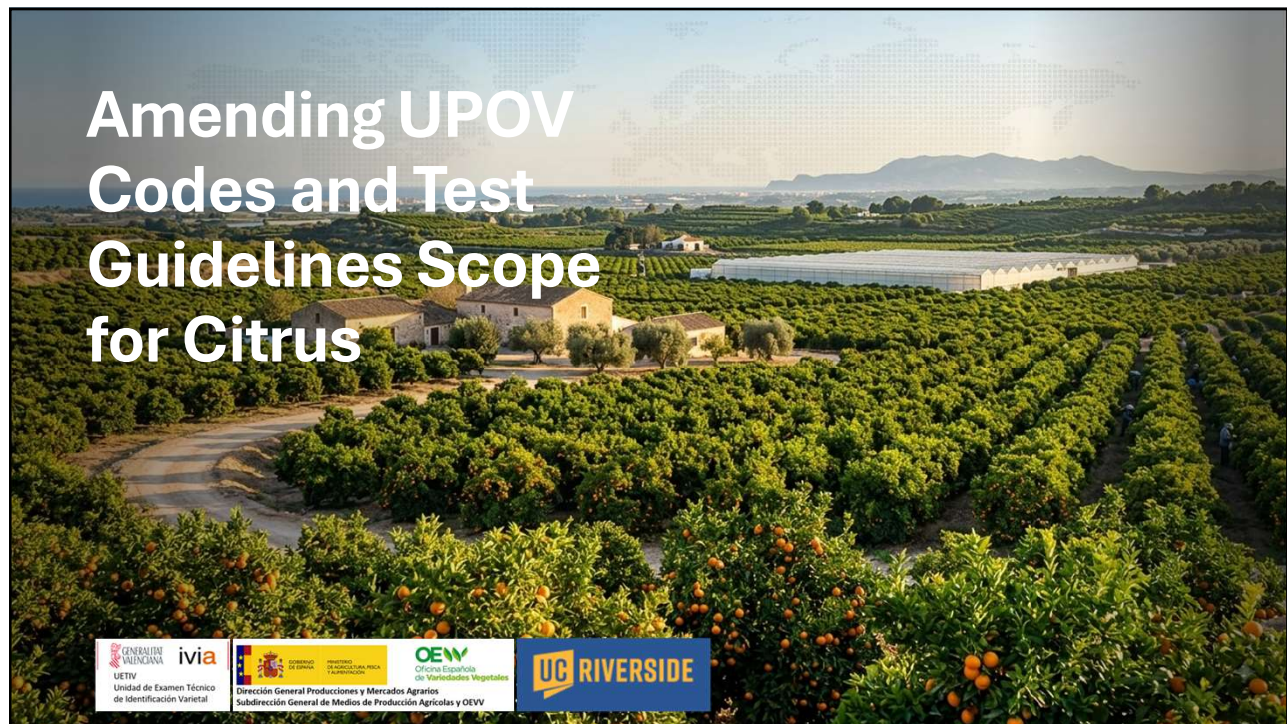
**ADDENDUM TO:
REPORT ON AMENDING UPOV CODES FOR CITRUS**

Document prepared by experts from Spain and the International Community of Breeders of Asexually Reproduced Horticultural Plants (CIOPORA)

Disclaimer: this document does not represent UPOV policies or guidance

The annex to this document contains a copy of a presentation on “Amending UPOV codes and Test Guidelines Scope for Citrus”, prepared by experts from Spain and the International Community of Breeders of Asexually Reproduced Horticultural Plants (CIOPORA), made at the fifty-seventh session of the TWF.

[Annex follows]



1

- Why is Citrus Classification so Challenging?

2

Key Drivers of Taxonomic Complexity in the Genus Citrus



1. Apomixis (Nucellar Polyembryony)

- ⇒ Production of embryos genetically identical to the maternal plant without fertilization
- ⇒ Natural seed-based cloning that stabilizes and perpetuates hybrids over time.

2. Absence of Reproductive Barriers

- ⇒ High interspecific compatibility and frequent hybridization that drive continuous genomic admixture.

3. Early Domestication

- ⇒ Ancient human selection and trade that dispersed taxa and blurred primary centers of origin.

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Centuries of frequent hybridization, natural cloning through apomixis, and human selection have resulted in thousands of hybrids and cultivars that defy traditional classifications

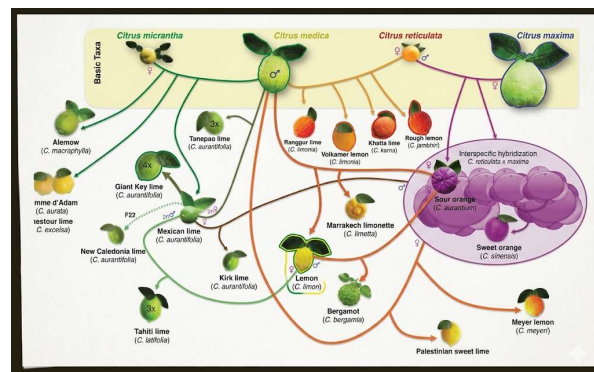


4

1. Linnaeus (1753) – <i>Species Plantarum</i>	4 sp
2. Risso & Poiteau (1818–1820)	18 sp
3. Swingle (1943)	16 sp
4. Tanaka (1932–1969)	162 sp
5. Mabberley (1997)	3 sp
6. Ollitrault, Curk, Krueger (2020)	4 sp



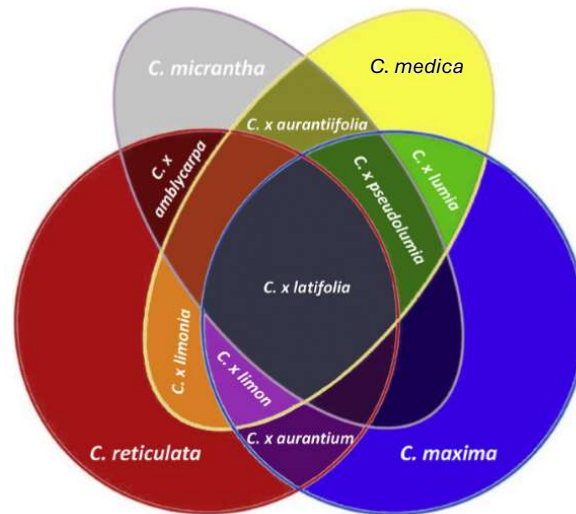
- Citron (*C. medica* L.)
- Wild mandarin (*C. reticulata* Blanco)
- Micrantha (*C. micrantha* Wester)
- Pummelo (*C. maxima* (Burm.) Merr.)



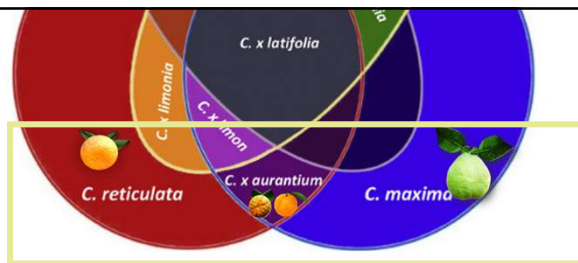
Ollitrault, Curk y Krueger Phylogenomic classification (2020)

- **Key concepts:**

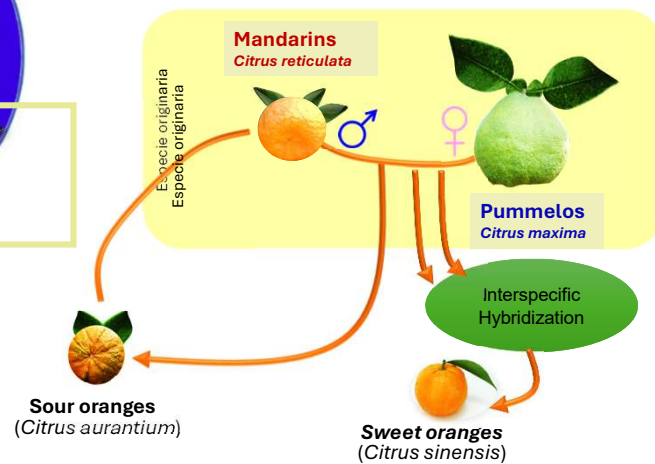
- The **species level** in hybrid crops is defined by the specific **combination of ancestors**.
- The **variety level** distinguishes each unique **reticulation event**.



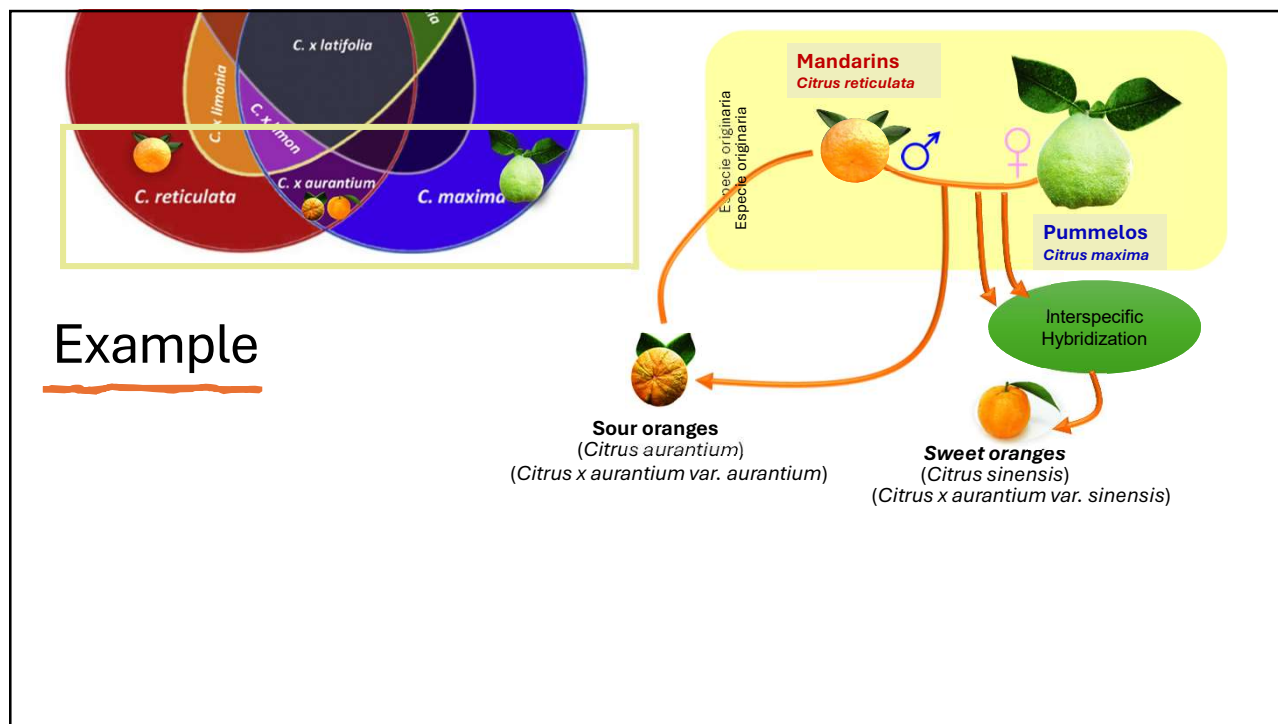
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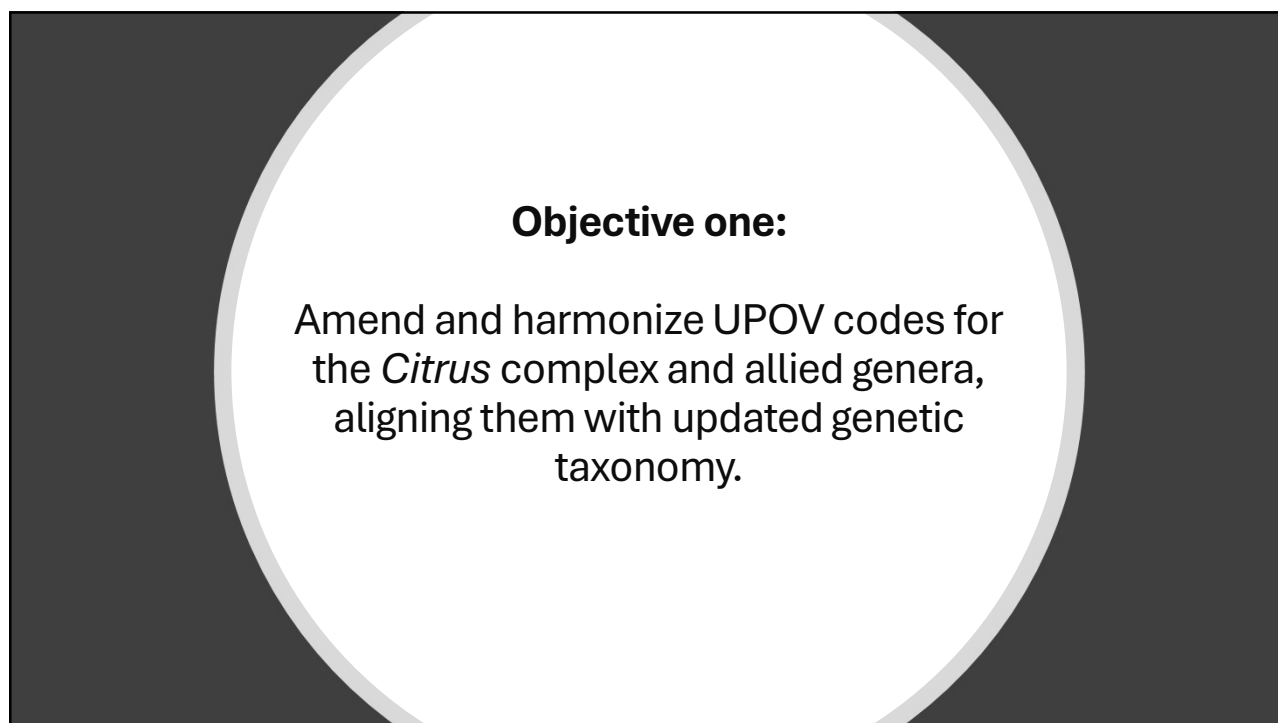
Example



8



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Background & Context

- **2020** – TWF 51+TC-56 → **Process initiated**
Inconsistencies identified with GRIN taxonomy
- **2021** – TWF-52 + TC-57 → **First change approved**
 - *C. clementina* → synonym of *C. aurantium* Code **CITRU_AUM** modified
 - Conflict: One code vs 2 TGs: Pragmatic solution: addition of 2 groups to the code:
 - CITRU_AUM_1MA → mandarins
 - CITRU_AUM_2OR → Oranges
 - Deletion of 11 codes (CITRU_CLE, CITRU_MRE, CITRU_CRE, CITRU_INT, CITRU_AUR, CITRU_DAV, CITRU_EXC, CITRU_KER, CITRU_BAL and CITRU_KAR and CITRU_BEN)
- **2022-2023** → Progressive implementation and monitoring of the changes already approved in 2021.
- **2024** – TC-60 → Proposal reclassification of the species ×*Citroncirus*, *Fortunella*, *Poncirus*
- **2025** – TWF-56 + TC-61 → **Second change approved**
Integration of the ×*Citroncirus*, *Fortunella*, *Poncirus* genera into the *Citrus* genus
- **2026** - **Process ongoing**
Detailed analysis of the rest of the citrus complex codes

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Advancing the Revision of *Citrus* UPOV Codes (2026)

→ Comprehensive Review of TWP/9/2

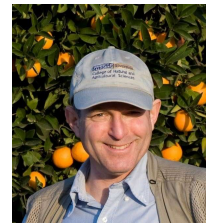
- D. Karp in consultation with citrus geneticists, taxonomists, and UPOV experts has completed a first draft of the proposed revision of the entire code spreadsheet. **161 old codes consolidated into 51 new codes**

→ Taxonomic Refinement

- While updated GRIN-Global taxonomy represented a substantial advance, minor errors and inconsistencies remained.

→ Recent Meetings (2026)

- **March 27:** Karp–Dr. Schori (USDA-ARS) meeting in Beltsville → Agreed on specific revisions and further research on unresolved cases.
- **April 17:** Hybrid working meeting (in-person at IVIA, Valencia + online) to review overall project progress.
- **September 4:** Karp–Dr. Schori met online for further review and resolution of remaining issues



Researcher,
Dept. of Botany and Plant Sci.,
University of California,
Riverside, USA

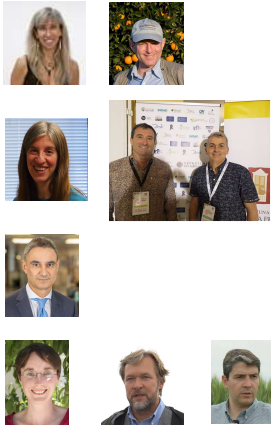


Valencian Institute for
Agronomical Research
IVIA

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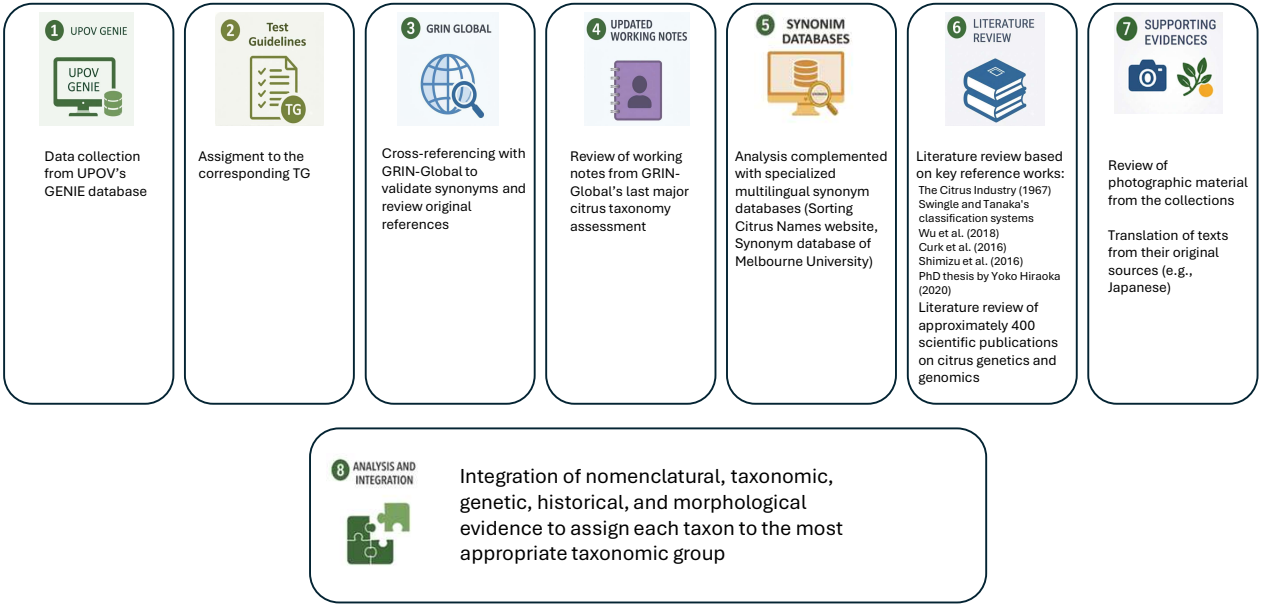
International Collaboration

Scope	Representatives / Participants
Revision Leads / Taxonomy	G. Ancillo (IVIA, Spain)
	D. Karp (UC Riverside / CIOPORA, USA)
Research & Genetics	M. Schori (USDA-ARS, USA)
	F. Curk (INRAE / CIRAD, France)
	F. Luro (INRAE, Corsica)
UPOV Secretariat & Officers	L. Taveira (UPOV)
Variety Authorities (TWF / CPVO / MAPA)	C. Dirwimmer (GEVES / TWF Chair, France)
	J. Wegner (CPVO, EU)
	C. Sanz Zudaire (OEVV / MAPA, Spain)



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Amendment Process: Materials and Methods



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Amendment of UPOV Citrus Codes: Most Significant Changes

1 Strict Retypification of *Citrus reticulata* (Mabberley & Xu, 2022–2024):

- Historically, the name *Citrus reticulata* was broadly used for commercial mandarins despite being hybrids.
- Following the conservation proposal approved in 2024, *Citrus reticulata* is now restricted **solely to pure, unadmixed wild mandarins** (without *C. maxima* introgression), typified using material from Hunan, China.



Amendment of UPOV Citrus Codes: Most Significant Changes

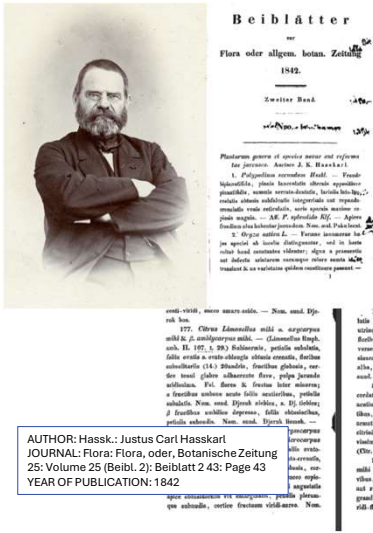
2 Creation of the *Citrus ×aurantium* L. var. *chrysocarpa* Mandarin Hybrid Group:

- Traditional cultivated mandarins and hybrids containing introgression from *C. maxima* (pummelo) are reclassified under this variety.
- They are subdivided into **early-admixture** mandarins (Type 2: e.g., Willowleaf, Cleopatra, ponkan, Dancy) and **late-admixture** mandarins (Type 3: e.g., clementine, satsuma, Murcott, Furr, and most modern hybrids).

photos by David
Karp
University of
California Riverside



TYPE 1 TYPE 2 TYPE 3
C. lycopersiformis Kishu Furr



Amendment of UPOV Citrus Codes: Most Significant Changes

3 Structuring of the Orange and Grapefruit Complex (*C. ×aurantium*):

- **var. *aurantium***: Strictly reserved for the **sour orange** (original direct hybrid).
- **var. *sinensis***: Sweet orange (derived from a backcross). Discussions remain open regarding a restrictive "originalist" approach versus a "inclusive" approach for recent sweet orange-like hybrids and other very similar taxa.
- **var. *racemosa***: Inclusive category encompassing the grapefruit and hybrids where pummelo phenotype and genotype predominate (e.g., Oroblanco, Hassaku, Natsudaikai).
- ***C. ×aurantium* (without variety)**: Functions as a "holding pen" for complex *reticulata*×*maxima* hybrids with insufficient data or intermediate characteristics (e.g., *C. intermedia* Tanaka).



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Amendment of UPOV Citrus Codes: Most Significant Changes

4 Revision of Lemons, Limes, and Relatives:

- ***Citrus ×limon***: Groups three-way hybrids (*reticulata* × *maxima* × *medica*), including true lemons, Meyer lemons, sweet limes, and bergamots.
- ***Citrus ×aurantiifolia***: Traditional acid limes (small-fruited limes, Mexican lime), formed by crosses of *C. hystrix* × *C. medica*.
- ***Citrus ×otaitensis*** (replacing older names like *C. limonia* or *C. volkameriana*): Designates Rangpur limes, Volkamer lemons, and rough lemons (*reticulata* × *medica*).
- **CITRU_HYB Category**: Used provisionally for taxa whose exact genetic ancestry remains unclarified (e.g., *C. assamensis*, *C. tamurana*) or for species combinations for which no recognized binomial exists.



Mexican lime



Eureka Lemon



Otaheite acidless Rangpur lime

photos by David
Karp
University of
California Riverside

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Amendment of UPOV Citrus Codes: Most Significant Changes

True *Citrus* species

<i>C. australasica</i>	<i>C. latipes</i> (?)
<i>C. australis</i>	<i>C. mangshanensis</i>
<i>C. cavaleriei</i>	<i>C. maxima</i>
<i>C. garrawayae</i>	<i>C. medica</i>
<i>C. glauca</i>	<i>C. polytrifolia</i> (?)
<i>C. gracilis</i>	<i>C. reticulata</i>
<i>C. hindsii</i>	<i>C. ryukyuensis</i> (?)
<i>C. hystrix</i>	<i>C. trifoliata</i>
<i>C. indica</i>	<i>C. venosa</i>
<i>C. inodora</i>	<i>C. warburgiana</i>
<i>C. japonica</i>	<i>C. wintersii</i>

Hybrid *Citrus* taxa (nothospecies)

	1. <i>C. ×amblycarpa</i> = <i>C. hystrix</i> × <i>C. reticulata</i> 2. <i>C. ×aurantifolia</i> = <i>C. hystrix</i> × <i>C. medica</i> (Mexican lime, Key lime) 3. <i>C. ×aurantium</i> = <i>C. maxima</i> × <i>C. reticulata</i> (grapefruit, mandarin, orange, tangerine, etc.) 4. <i>C. ×floridana</i> = <i>C. japonica</i> × <i>C. maxima</i> × <i>C. reticulata</i> (limequat) 5. <i>C. ×georgiana</i> = <i>C. japonica</i> × <i>C. maxima</i> × <i>C. reticulata</i> × <i>C. trifoliata</i> (citrangequat) 6. <i>C. ×granulata</i> (syn. <i>C. ×limonia</i> auct. non Osbeck 1765; <i>C. ×jambhiri</i>) = <i>C. medica</i> × <i>C. reticulata</i> (red rough lemon) 7. <i>C. ×insitum</i> = <i>C. maxima</i> × <i>C. reticulata</i> × <i>C. trifoliata</i> 8. <i>C. ×junos</i> = ? possibly <i>C. cavaleriei</i> × <i>C. maxima</i> (yuzu) 9. <i>C. ×latifolia</i> = <i>C. hystrix</i> × <i>C. maxima</i> × <i>C. medica</i> × <i>C. reticulata</i> (Tahitian lime) 10. <i>C. ×limon</i> = <i>C. maxima</i> × <i>C. medica</i> × <i>C. reticulata</i> (Eureka lemon, Meyer lemon, bergamot) 11. <i>C. ×lumia</i> = <i>C. maxima</i> × <i>C. medica</i> (Ponderosa lemon) 12. <i>C. ×microcarpa</i> = <i>C. japonica</i> × <i>C. reticulata</i> (calamansi, calamondin) 13. <i>C. ×oliveri</i> = <i>C. australasica</i> × <i>C. japonica</i> × <i>C. reticulata</i> (sunrise lime) 14. <i>C. ×virgata</i> = <i>C. australasica</i> × <i>C. australis</i> (Sydney lime)
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Source: M. Schori, Updating *Citrus* Nomenclature and Classification, 2020

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Outstanding Issues for Further Discussion

 **The *Citrus hystrix* dilemma:** *C. micrantha* becomes *C. hystrix*, creating practical confusion as it will be unclear whether the use of *C. hystrix* refers to the Thai lime or to *C. micrantha*. Have we done sufficient germplasm and genetic analysis of papedas?

 **Limits in *C. var. sinensis*:** ("Originalist" vs. "inclusive" approaches): Ongoing debate on whether to restrict it to the original cross/mutations or include recent sweet-like hybrids (e.g., 'Ambersweet', 'US SunDragon').

From a scientific point of view, the decision must be based on genetics and phenotype, restricted to the original cross and derivatives via mutation (without further sexual crosses). However, potential implications exist for juice standards of identity in certain countries.

 **Cultural inertia in *Chrysocarpa*:** Historically, the name *C. reticulata* was broadly used for commercial mandarins despite being hybrids. Now, this name is restricted solely to pure mandarins, while hybrids are classified as *chrysocarpa*. Habits are difficult to change in practice (e.g., *C. maxima* is still called *C. grandis* by many people).



From a scientific point of view, it is important to point out problems and encourage reflection on the tool, prioritizing utility over strict rules. A classification must not only be taxonomically correct; it must also be:

Useful / Usable / Used.

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Next Steps & Roadmap



- ➔ **September 7–10 (Leipzig):** Present the revision at the **TWF/57** session.
- ➔ **September 14–18 (Geneva):** Finalize the document with UPOV technical experts, incorporating TWF feedback.
- ➔ **September 22 (Riverside, Calif.):** Presentation at the USDA's citrus germplasm committee meeting.
- ➔ **October 19–20:** Submit the proposal to the **UPOV Technical Committee (TC/62)** for consideration (conditional on principal botanical names being reflected in GRIN).
- ➔ **November 17–19 (Bastia, Corsica):** Scientific presentation (**Dr. Ancillo & D. Karp**) on the UPOV Citrus code revision and related GRIN-Global taxonomic updates to the scientific community.
- ➔ **Jan-Feb 2027 (Dallas):** Webinar on the citrus recoding project invited by the citrus working group of the American Society for Horticultural Science.

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Objective two:

Redefine the scope of 5 Test Guidelines

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Key purposes:



Clarity of Scope

Each Test Guideline (TG) unambiguously defines which species, hybrids, or variety groups it directly applies to.



No Overlaps

Eliminates uncertainty regarding which guideline to use when registering complex varieties or those originated through hybridization.



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State of Play and Preliminary Overview:



- ➔ The revision of the scope for the five Citrus Test Guidelines (TG/83, TG/201, TG/202, TG/203, and TG/204) cannot be fully finalized until the comprehensive amendment of the UPOV codes for Citrus is formally implemented.
- ➔ However, as a preliminary indication, based on the revised botanical nomenclature and taxonomic framework adopted for this restructuring, it can be anticipated that the respective scope of each Test Guideline will be structured as follows:

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TG/83

The image shows the title page of a book. At the top left, it says 'TG/83'. In the center, there is a small logo with the word 'TRIFOLIATE' inside a circle. To the right of the logo, it says 'TRIFOLIATE, Inc.' and '1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636

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TG/203



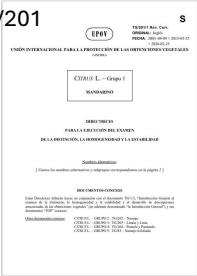
Lemons
and limes

<i>C. ×aurantiifolia</i> var. <i>aurantiifolia</i>
<i>C. ×aurantiifolia</i> var. <i>macrophylla</i>
<i>C. ×aurantiifolia</i> var. <i>aurata</i>
<i>C. ×latifolia</i> var. <i>nov 1</i>
<i>C. ×latifolia</i> var. <i>nov 2</i>
<i>C. ×latifolia</i> var. <i>latifolia</i>
<i>C. ×limon</i> var. <i>bergamia</i>
<i>C. ×limon</i> var. <i>meyerii</i>
<i>C. ×limon</i> var. <i>limettioides</i>
<i>C. ×limon</i> var. <i>limetta</i>
<i>C. ×limon</i> var. <i>limon</i> (L.) Burm. f.
<i>C. ×otaitensis</i> var. <i>nov 1</i>
<i>C. ×otaitensis</i> var. <i>nov 2</i>
<i>C. ×otaitensis</i> var. <i>jambhiri</i>
<i>C. ×otaitensis</i> Osbeck var. <i>limonia</i>
<i>C. ×otaitensis</i> var. <i>volkameriana</i>
<i>C. ×lumia</i> var. <i>nov 1</i>
<i>C. ×lumia</i> var. <i>lumia</i>
<i>C. ×lumia</i> var. <i>pyriformis</i>
Hybrids



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TG/201

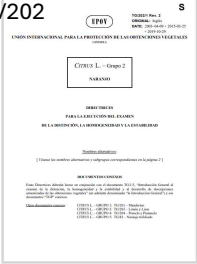


Orange

Mandarin

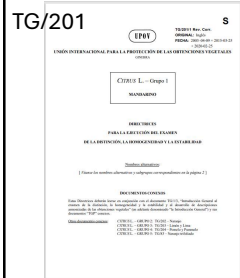


TG/202



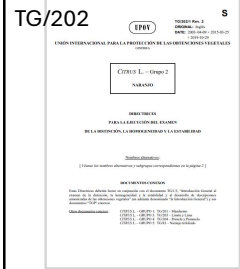
Distinguishing between an orange and a mandarin might seem straightforward

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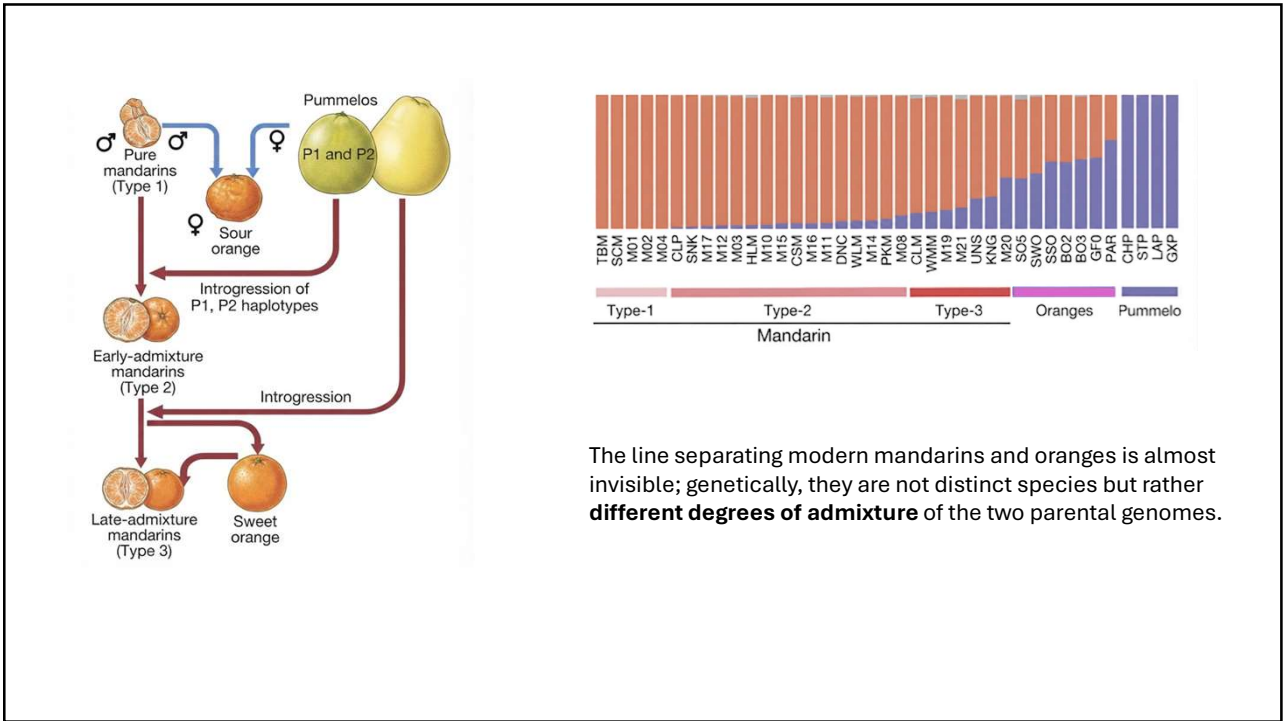


Orange

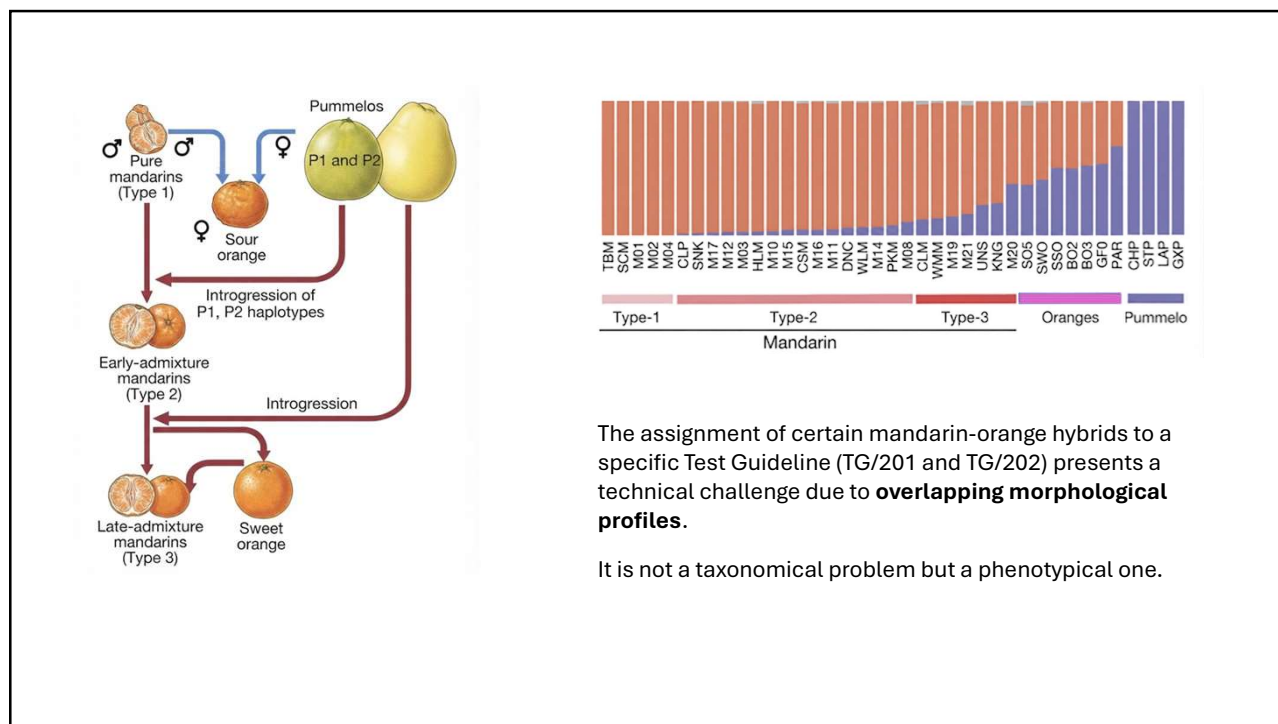
Mandarin



Distinguishing between an orange and a mandarin might seem straightforward, but in reality, this is not the case



The line separating modern mandarins and oranges is almost invisible; genetically, they are not distinct species but rather **different degrees of admixture** of the two parental genomes.



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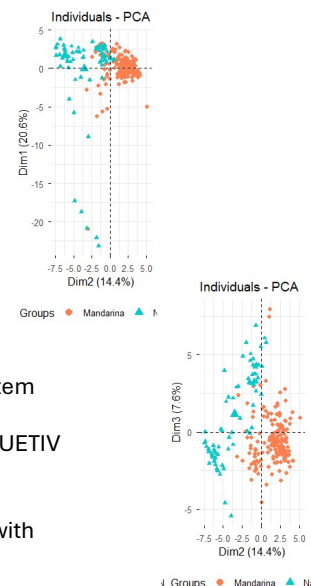
Two main approaches are considered:

Option A: Examiner expertise (based on key diagnostic traits).

- Leaf blade: length/width ratio
- Fruit: diameter (mm)
- Fruit: height/diameter ratio
- Fruit: predominant colour
- Fruit: Adherence of rind to flesh
- Fruit: Filling of central cavity
- Fruit: Adherence between segment walls
- Fruit: Firmness of segment walls

Option B (under development): An objective, mathematically driven scoring system

1. Statistical Analysis: Principal Component Analysis (PCA) performed on UETIV reference database for mandarins and oranges for identification of the characteristics with the highest discriminating weight.
2. Implementation: Development of a weighted "mini-pre-test guideline" with these traits to assign varieties objectively based on its final score.



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Direct Impact on Variety Registration



Streamlined Applications

Breeders can select the appropriate UPOV code and TG guideline with absolute certainty from the initial filing.



Optimization of DUS Testing

Examination stations avoid methodological doubts regarding which variety collection to use for character comparison.



Consistency in GENIE and PLUTO Databases

Unambiguous novelty searches and variety denominations worldwide across the Genie and PLUTO Databases.



Strengthened Legal Protection

More solid protection titles, backed by guidelines with a perfectly defined scope and technical background.

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Main Conclusion

The amending of UPOV codes and the redefinition of the scope of test guidelines will guarantee a robust, modern, and technically coherent registration system

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THANKS FOR
YOUR
ATTENTION



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