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'US-Gallasch': A New Citrus Rootstock 60 Years in the Making

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'US-Gallasch' is a new citrus rootstock released by the Queensland Department of Primary Industries (QDPI) for wider testing in nurseries and by citrus growers. This hybrid selection was originally produced from a cross made in 1962, in the citrus breeding program of the US Department of Agriculture (USDA) at Indio, CA, USA. The major positive attributes of this rootstock are excellent resistance to *Citrus tristeza virus* (CTV), salt tolerance, graft union compatibility, and induction of moderate tree size, with good productivity and fruit quality. 'US-Gallasch' can be uniformly and efficiently propagated by apomictic seed, showing desirable nursery growth characteristics. The release of this rootstock follows a long path from its original creation, with research on two continents and the revelation that this parental combination warrants closer consideration by rootstock breeders.

Origin and History

'US-Gallasch' originates from a 1962 cross of 'Sunki' mandarin (*Citrus reticulata* var. *austera*) by 'Flying Dragon' trifoliate orange (*C. trifoliata*, syn *Poncirus trifoliata*) made by Joseph Furr (Plant Breeder, USDA-ARS Citrus & Date Station, Indio, CA, USA). This cross was one of 49 hybrid families produced that year in a program specifically focused on developing rootstocks with improved tolerance to *Phytophthora* and salinity (Furr and Carpenter 1961; Furr et al. 1963). Seed from the original hybrid tree (coded as 62-109-40) first became available in 1974 and was tested by John Carpenter (Pathologist, USDA-ARS Citrus & Date Station, Indio, CA, USA) for polyembryonic seed morphology and seedling uniformity (indicative of apomixis), *Phytophthora* root rot tolerance and confirmation of salt tolerance. Results were confirmed on a second batch of seed recollected from the original hybrid tree in 1975 (USDA Indio Station Accession Records 1965–81, p 191, 207) and the hybrid was identified as promising for these traits.

The decision to close the Indio field station in the late 1970s and consolidate USDA citrus breeding in Orlando, FL, USA coincided with a period in Australia where salinity was a major industry problem. Peter Gallasch, based at Loxton Research Centre (LRC) in South Australia, was searching for rootstock germplasm as a solution to salinity and was well connected with international citrus scientists. It was serendipitous that Australia's urgent need for salt-tolerant rootstocks coincided with the consolidation of USDA activities, and John Carpenter was "desperate" (Gallasch P, personal communication, Oct 2004) to see the breeding efforts at Indio preserved and the best material continue to be developed. Consequently, Carpenter collected seed from what he considered to be the best 28 rootstock hybrids at USDA-ARS Citrus & Date Station, Indio, and sent these seed lots to LRC for testing in 1981. The Indio selection 62-109-40, which was to become 'US-Gallasch', was not in the top six performers during the LRC testing (partly on account of its smaller tree size) but was

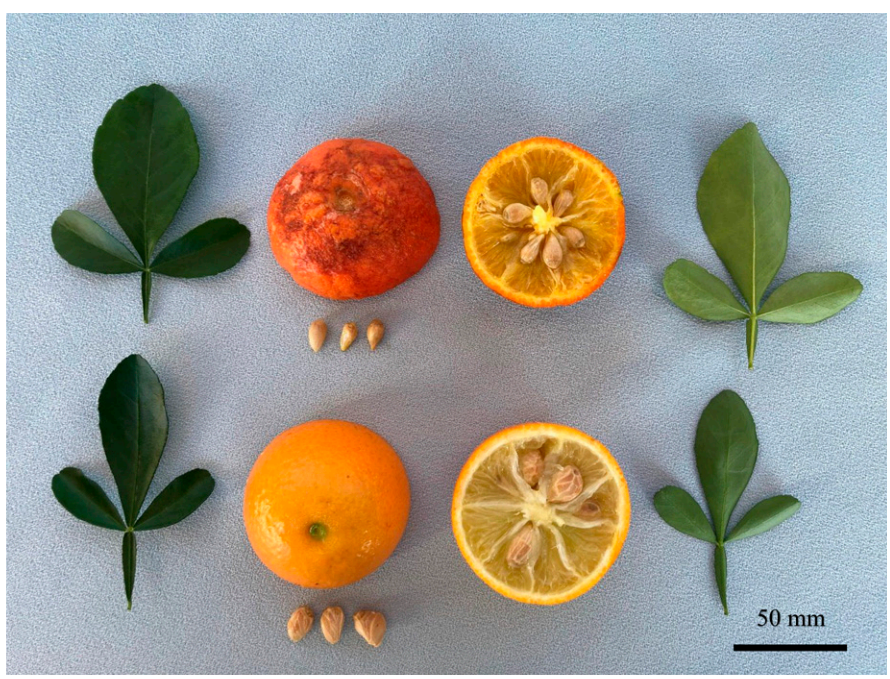

Fig. 1. Leaves, fruit, and seeds of 'US-Gallasch' (top) compared with 'Troyer' (bottom). The 'US-Gallasch' fruit shown in the picture is overmature and showing signs of peel breakdown; natural abscission occurs midwinter under subtropical conditions.

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Table 1. Available single nucleotide polymorphism (SNP) data for 'US-Gallasch' and 32 other citrus rootstocks for 21 locations spread across all nine Linkage Groups. The first five SNPs are trait-linked as per Montalt et al. (2023), Ohta et al. (2015), Cuenca et al. (2016), and Huang et al. (2018), respectively. The remaining SNPs were developed by University of California at Riverside (UCR) for citrus cultivar identification. All data from Queensland Department of Primary Industries except the seven accessions without *Citrus tristeza virus* (CTV) information, which is data from UCR. Green cells indicate heterozygous alleles while those in blue and yellow are homozygous. Clear cells indicate Locations that were not analyzed for specific accessions.

Rootstock	Apomixis	CTV	Alternaria	HLB-6	HLB-9	AX-160230679	AX-160091999	AX-159819388	AX-160240249	AX-160263092	AX-159972794	AX-159825908	AX-160721997	AX-161006189	AX-161029795	AX-161043677	AX-159876650	AX-160077550	AX-160809884	AX-160300625	AX-160763815
US-Gallasch	C:T	A:G	T:T	C:C	T:T		G:A		T:T	G:G	T:C	A:A		A:A	G:A		C:C			T:C	C:C
Barkley	C:T	G:G	T:T	C:C	T:T	G:A	G:A	A:A	T:T	G:G	T:C	A:A	T:T	A:A	G:A	C:C	C:C	C:C	C:C	T:C	T:C
Benton	C:T	A:G	T:G	T:C	A:T	G:A	G:A	G:A	T:T	G:G	T:T	A:A	T:C	G:A	G:A	T:C	T:C	C:C	T:T	T:C	T:C
C22 Bitters		A:G	T:T	C:C	A:T	A:A	G:A	A:A	T:T	G:G	T:C	A:A	T:T	A:A	G:A	T:C	C:C	C:C	T:C	C:C	C:C
C54 Carpenter		G:G	T:T	C:C	A:T	A:A	G:A	A:A	T:T	G:G	T:C	A:A	T:T	A:A	G:A	T:C	T:C	C:C	T:C	C:C	C:C
C57 Furr		G:G	T:T	C:C	A:T	A:A	G:A	A:A	T:T	G:G	T:T	A:A	T:T	A:A	G:A	T:C	C:C	C:C	T:C	T:C	C:C
C146		G:G	T:T	C:C	A:T	A:A	G:A	A:A	T:T	G:G	T:T	A:A	T:T	A:A	G:A	T:C	C:C	C:C	T:C	T:C	C:C
Cleopatra	C:T	G:G	T:T	C:C	T:T	G:A	G:G	A:A	T:T	G:G	T:C	A:A	T:T	G:A	G:A	C:C	T:T	C:C		C:C	C:C
Fraser		G:G	T:T	T:C	A:T	G:A	G:A	G:A	T:T	G:A	T:T	A:A	T:C	G:A	G:G	T:C	T:C	C:C	T:C	C:C	C:C
ICA12		A:G	T:T	T:C		A:A	A:A	A:A	T:C	G:G	T:T	A:A	T:T	A:A	G:G	T:T	T:C	C:C	T:T	T:C	C:C
Macrophylla						A:A	A:A	G:G	C:C	G:G	T:T	A:A	T:T	A:A	G:G	T:T	C:C	C:C	T:T	T:C	C:C
Morton						G:A	G:A	G:G	T:T	G:A	T:T	C:A	T:C	G:A	G:A	T:T	T:C	C:C	T:T	C:C	T:C
Ponkan		G:G	T:G	C:C	T:T	G:A	G:A	G:A	T:C	G:G	T:C	A:A	T:T	G:A	G:A	C:C	C:C	C:A	C:C	C:C	T:C
Rough lemon	C:T	G:G	T:T	C:C	T:T	A:A	A:A	G:A	T:C	G:G	T:T	A:A	T:T	A:A	G:A	T:C	T:C	C:C	T:C	T:C	C:C
Rusk						A:A	A:A	G:A	T:T	G:G	T:C	C:A	T:C	G:A	G:A	T:C	T:C	C:A	T:C	T:C	T:C
Savage	C:T	G:G	T:T	C:C	T:T	G:A	G:A	G:A	T:C	G:A	T:C	C:A	T:C	G:A	G:G	T:C	C:C	C:A	T:T	C:C	C:C
Sour orange	C:T	G:G	T:T	C:C	T:T		G:A		T:T	G:A	T:T	A:A		A:A	G:G		T:C			T:T	C:C
Sunki CO103	T:T	G:G	T:T	C:C	T:T		G:G		T:T	G:G	C:C	C:C		G:G	G:G		C:C			C:C	C:C
Sunki CRC 3143						G:A	G:G	A:A	T:T	G:G	C:C	C:A	T:T	G:G	G:G	C:C	C:C	C:C	C:C	C:C	C:C
Sunki RRUT 444						G:A	G:G	A:A	T:T	G:G	T:C	A:A	T:T	A:A	G:A	C:C	T:C	C:C	C:C	T:C	C:C
Sweet orange		G:G	T:G	C:C	T:T	G:A	G:A	G:G	T:C	G:A	T:C	C:A	T:C	G:A	G:A	T:C	T:C	C:A	T:C	T:T	T:C
Swingle	T:T	G:G	T:G	C:C	T:T		A:A		T:C	G:A	T:C	C:A		A:A	G:G		T:C			T:C	T:C
Tri22	T:T	A:G	T:T	T:C	A:T	A:A	A:A	A:A	T:T	G:G	T:T	A:A	T:T	A:A	G:G	T:T	C:C	C:C	T:T	C:C	C:C
Troyer	C:T	A:G	T:T	C:C	T:T	G:A	G:A	G:A	T:C	G:G	T:T	A:A	T:C	A:A	G:G	T:C	C:C	C:C	T:T	C:C	T:C
US-119		A:G	T:T	C:C	A:T	G:G	G:A	G:A	T:C	G:A	T:T	C:A	T:T	G:G	G:G	T:C	T:C	C:A	T:C	C:C	C:C
US-802	T:T	G:G	T:T	T:C	T:T		A:A		T:C	G:A	T:T	A:A		A:A	G:G		C:C			C:C	C:C
US-812	C:T	G:G	T:T	C:C	A:T	G:A	G:A	A:A	T:T	G:G	T:T	A:A	T:T	A:A	G:G	T:C	C:C	C:C	T:C	T:C	C:C
US-942	C:T	A:G	T:T	C:C	T:T		G:A		T:T	G:G	T:C	A:A		A:A	G:A		T:C			C:C	C:C
Volkameriana						A:A	G:A	G:A	T:C	G:G	T:T	A:A	T:T	A:A	G:A	T:C	T:C	C:C	T:C	T:C	C:C
Yuma						G:A	G:A	G:A	T:C	G:A	T:T	C:A	T:C	G:A	G:G	T:C	T:C	C:A	T:C	C:C	C:C
NSW-3822		G:G	T:T	C:C	T:T	A:A	A:A	A:A	T:C	G:G	T:T	A:A	T:T	A:A	G:A	T:C	T:C	C:C	T:C	C:C	C:C
NSW-3834		A:G	T:T	C:C	T:T	A:A	A:A	G:A	T:C	G:A	T:C	A:A	T:T	G:A	G:G	T:C	C:C	C:C	T:T	C:C	C:C
USDA-63-199-49		A:G	T:T	T:C	T:T	G:A	G:A	A:A	T:T	G:G	T:C	A:A	T:T	A:A	G:A	T:C	C:C	C:C	T:C	C:C	C:C
Linkage Group	1	2	3	6	9	1	1	2	2	3	4	5	5	6	6	7	7	8	8	9	9
Location	25497528	13195132	25862085	19837597	22115818	528900	27769136	35674407	11394067	10244234	24346578	72022	41365556	13756236	25198776	1434081	20079592	63799	21061871	375229	29404336

reassessed in renewed QDPI research commencing in 2004. Extensive nursery and field experiments by QDPI from 2008 to 2024 (discussed subsequently) have shown consistently promising performance from 'US-Gallasch' that justify wider distribution and evaluation of this rootstock hybrid, created more than 60 years ago.

Description

Mature seedling trees of 'US-Gallasch' are moderately vigorous with dark green foliage that is retained during winter temperatures under subtropical conditions. Leaves are uniformly trifoliate, resembling the ubiquitous 'Troyer' but with all three leaflets being broader and a more-prominently yellow-green main vein on the abaxial surface (right image on Fig. 1). The fruit has a rough peel texture, a red-orange external color, and an orange internal color at maturity ('Troyer' is smooth with yellow-orange external and internal colors). Seeds of 'US-Gallasch' are more elongate and somewhat smaller than those of 'Troyer' (Fig. 1).

Flowers are perfect (functionally female and male fertile) and have been successfully used as both male and female parents in rootstock breeding (although the frequency of zygotic seedlings when used as a seed parent is low). Trees produce a heavy crop of fruit each season, and seed numbers and quality are good. Germination rates and seedling uniformity are high, and the seedlings grow well in the nursery with a growth rate somewhat slower than 'Troyer' seedlings. They have been readily budded with a range of different scions, including 'Afourer', 'Imperial', 'Murcott', and 'Premier' mandarins, and 'Valencia' and 'Washington' sweet oranges.

Molecular data are available to distinguish 'US-Gallasch' from other rootstocks. Table 1 provides single nucleotide polymorphism (SNP) information for 'US-Gallasch' and 32 other commercial, near-commercial, or historically important rootstocks. The location of the 22 SNPs on the Clementine v1.0 genome assembly (www.citrusgenomedb.org) is shown at the bottom of Table 1 and can be used to develop comparative data for additional rootstock cultivars as required. QDPI SNP data were generated using Kompetitive Allele Specific Polymer Chain Reaction

Fig. 2. Graft union of 9-year-old 'Imperial' mandarin trees on (L to R) 'US-Gallasch', 'Troyer', and 'Swingle' rootstocks (Emerald, Queensland, planted 2011).

(KASP) assays (biosearchtech.com), and SNP data from the University of California, Riverside, USA (UCR) was extracted from an Affymetrix SNP array (Hiraoka et al. 2024).

Field Performance

'US-Gallasch' has been widely tested in seven rootstock field trials in Queensland, Australia (Qld), with the earliest of these planted in 2011 (Smith 2024), as well as a field trial in California, USA, planted in 1989 (Roose 2003). This is in addition to two earlier field trials in southern Australia and semi-commercial plantings of 446 trees in Qld in 2020. The rootstock has shown consistently superior performance for a number of important traits at these field sites.

'US-Gallasch' shows excellent graft compatibility with 'Imperial' mandarin (*C. reticulata*), which is a scion cultivar notorious for incompatibility, with commercial groves on 'Troyer' seldom surviving more than 15 years and 'Swingle' rootstock even less (Fig. 2, Table 2).

Graft union incompatibility is such an important issue with 'Imperial' mandarin that rootstocks such as 'Troyer' and 'Swingle' are no longer used in commercial groves or included in field experiments. Identifying good graft union compatibility is a challenging and ongoing issue in citrus rootstock breeding, recognized by Bitters et al. (1973) who stated: "Of concern, also, are the number of stock-scion incompatibilities which have appeared in the 1968–69 plantings as they did on previous plantings. These have occurred predominately on trifoliate orange hybrids … one wonders how well defined this situation may be with varying combinations or as the combinations grow older." The delayed onset of tree death from incompatibility (>10 years after field planting) can follow promising early performance from certain rootstocks (Caruso et al. 2024; Skewes et al. 2017) with graft union morphology on young trees being the only means of estimating the likelihood of future problems. In another trial planted in 2016, 'US-Gallasch' has again shown excellent graft union morphology, comparable with the three control rootstocks that have been identified in previous research (Table 3).

The trials described in Tables 2 and 3 have demonstrated good performance for other important traits such as crop density, tree health, freeze survival, fruit size, and fruit granulation. Assessments of Brix, acidity, and internal maturity time (BrimA) made at years 8 and 11 in the Table 2 trial, indicate that 'US-Gallasch' was comparable to the nine other rootstocks for these important fruit quality traits (significance range 0.06 to 0.85; data not shown).

Trees on 'US-Gallasch' rootstock establish well (and make good resets), and there have been no instances of tree loss within any field experiments, and only 2.5% loss after 4 years in the semicommercial plantings. Scions are moderately vigorous on this rootstock while showing good tree health and productivity. In the same field experiment described in Table 3, trees on 'US-Gallasch' have shown lower vigor than the three control rootstocks while retaining good tree health (Fig. 3), suggesting that this rootstock may provide an opportunity to avoid the excessive vigor often linked to good rootstock performance.

In an older field experiment, planted in 2011 and since removed, these differences in vigor were more difficult to quantify because of annual mechanical hedging and topping of the tree rows, which kept all treatment canopies to a similar volume. Nonetheless, measurements of trunk circumference below the graft union, and of canopy volume 11 months after hedging and topping, demonstrate that 'US-Gallasch' was less vigorous than some commonly used commercial rootstocks (Table 2).

These field trial results, and our observations of semicommercial plantings made in 2020, suggest that 'US-Gallasch' warrants testing in situations where growers are looking for the strong tree establishment obtained with traditional rootstocks like 'Troyer', but with less of the vigor that can become problematic as groves age.

Although current field trials have not been subject to salt stress, there is substantial evidence that 'US-Gallasch' should perform well under such conditions. In work aimed at breeding new salt-tolerant rootstocks, 'US-Gallasch' has been used as the donor parent, with nursery screening results showing that it resists the accumulation of leaf chloride and does not develop salt damage symptoms. When used as a parent, 'US-Gallasch' can pass these useful salt tolerance traits to its progeny (Smith 2018). Table 4 shows leaf chloride levels and visual salt damage symptoms for 'US-Gallasch'

Table 2. Graft benching of 'US-Gallasch' compared with nine selected rootstocks, and including other performance traits associated with tree size, productivity, and fruit quality, 'Imperial' mandarin (Emerald, Queensland, Australia, planted 2011).

Rootstock	Graft benching[i]	Trunk circ. (mm)[ii]	Canopy volume (m^3)[iii]	Crop density[iv]	Fruit size (g)[v]	Fruit granulation[vi]
'US-Gallasch'	0.65 bc	591 b	15.1 ab	4.2 abc	109 abc	2.03 ab
Benton	0.72 a	571 b	15.2 ab	4.9 a	104 abc	2.57 c
C22 Bitters	0.66 bc	578 b	15.3 ab	4.7 ab	109 bc	2.23 abc
C54 Carpenter	0.61 d	676 ab	16.7 a	3.6 abc	99 c	2.04 ab
C57 Furr	0.60 de	673 ab	16.9 a	3.5 bc	102 abc	2.01 ab
Cleopatra	0.67 b	672 ab	16.0 ab	3.3 c	100 ab	1.98 ab
Swingle	0.54 ef	693 ab	16.0 ab	4.8 abc	115 abc	2.18 abc
Trifoliata (Tri-22)	0.53 f	601 b	15.2 ab	4.2 abc	99 abc	2.45 abc
Troyer	0.62 cd	759 a	15.3 ab	4.1 abc	110 abc	2.56 bc
US-812	0.62 cd	593 b	14.6 b	3.5 abc	113 a	1.94 a
Significance	<0.001	<0.001	0.004	0.004	<0.001	0.002

[i] Ratio of trunk circumference 100 mm above and below union measured at 8 years.
[ii] Trunk circumference measured 100 mm below the graft union at 8 years.
[iii] Canopy volume measured using LiDAR (GreenAtlas, McEvoy St. NSW 2015, Australia, www.greenatlas.com) at 11 years.
[iv] Rating scale 0 = no fruit, 6 = desirable crop load, 10 = over-cropping, averaged for first 8 years of cropping.
[v] Averaged for first 8 years of cropping.
[vi] Rating scale 0 = no dryness, 3 = limit of acceptability, 5 = flesh completely dry (Hofman et al. 2024), averaged for first 8 years of cropping.
Mean groups for significant analysis of variance within columns were by Tukey test at $P < 0.05$.

Table 3. Comparative performance of 'US-Gallasch' against three well-adapted control rootstocks for 'Imperial' mandarin (Wallaville, Queensland, Australia, planted 2016).

Rootstock	Graft benching[i]	Tree health[ii]	Freeze survival[iii]	Crop density[iv]	Fruit size (g)[v]	Fruit granulation[vi]
'US-Gallasch'	0.75 bc	8.8 b	6.6	5.4	93	1.15
Barkley	0.86 a	9.6 a	6.9	5.0	94	1.08
Benton	0.79 b	9.4 ab	6.5	6.0	88	1.15
US-812	0.71 c	8.8 b	6.9	5.0	89	0.81
Significance	<0.001	0.005	0.082	0.055	0.328	0.071

[i] Ratio of trunk circumference 100 mm above and below union measured at 8 years.
[ii] Rating scale 0 = dead to 10 = extremely healthy, measured at 8 years.
[iii] Rating scale 0 = dead to 7 = no obvious damage, measured 1 month after a −5 °C event with no prior acclimation at 22 months after planting (more than one-third of the trees in the experiment were killed, all trees on these four rootstocks survived).
[iv] Rating scale 0 = no fruit, 6 = desirable crop load, 10 = over-cropping, averaged for years 6 to 8.
[v] Averaged for years 6 to 8.
[vi] Rating scale 0 = no dryness, 3 = limit of acceptability, 5 = flesh completely dry (Hofman et al. 2024), averaged for years 6 to 8.
Mean groups for significant analysis of variance within columns were by Tukey test at $P < 0.05$.

compared with 'Troyer' and 'Flying Dragon' after treatment with saline irrigation water.

'US-Gallasch' was one of the best for chloride exclusion of the original 28 Indio selections sent to Australia (which had been specifically bred, screened and selected for salt tolerance) and deliberate salt treatment did not reduce the growth rate of 'US-Gallasch' seedlings (Gallasch and Dalton 1989). This consistent performance of 'US-Gallasch' is noteworthy given that Furr and Ream (1969) specifically mentioned 'Sunki' × 'Flying Dragon' as a cross from which it was difficult to identify salt-tolerant individuals.

Similarly, 'US-Gallasch' has excellent tolerance to CTV and should prove well adapted to locations where this virus continues to limit rootstock choices. In an assessment of 39 nucellar genotypes, 'US-Gallasch' provided the strongest resistance to virus replication following a severe screening test designed to examine replication and movement, even outperforming *C. trifoliata* (Smith et al. 2016). Earlier work (Broadbent and Gollnow 1992, 1993) had shown that 'US-Gallasch' remained free of symptoms when inoculated with "seedling yellows" and "stem pitting" isolates of CTV, and with virus titer (determined by enzyme-linked immunoassay) the same as untreated controls. Molecular testing (Table 1) has confirmed that 'US-Gallasch' carries the CTV resistance gene inherited from *C. trifoliata*. It has been the main donor parent used to successfully introgress CTV resistance into the highly CTV-sensitive wild citrus species that are endemic to Australia and Papua New Guinea (Smith et al. 2024).

Rootstock Parentage and Breeding

It has not escaped our attention that the parentage of 'US-Gallasch' is identical to another USDA-bred citrus rootstock that has quickly come to dominate commercial plantings in Florida, namely 'US-942' (Bowman and Joubert 2020; Bowman and McCollum 2010; Bowman et al. 2016a, 2016b). Furthermore, the most promising new rootstock likely to be soon released from the University of UCR program also has identical parentage to 'US-Gallasch' and 'US-942'. It is intriguing that three widely dispersed rootstock programs (Australia, California, Florida) would identify promising rootstocks with identical parentage, 'Sunki' × 'Flying Dragon'. The comparative performance of these three siblings, and other progeny with this parentage, warrants wider assessment across a range of scions and growing conditions. Breeders looking to repeat this 'Sunki' × 'Flying Dragon' cross should take care that their accession of 'Sunki] corresponds with what was previously used at USDA Indio and what is currently being used at USDA Fort Pierce (Sunki RRUT 444, Table 1). The main accession of 'Sunki' held at Riverside (Sunki CRC 3143, Table 1) and the single accession in Australia (Sunki CO103, Table 1) are not the 'Sunki' parent used to produce 'US-Gallasch' or any other recently released rootstocks.

The release of 'US-Gallasch' is a reminder that foundational work performed at USDA Indio more than 60 years ago and subsequent international efforts by scientists to preserve and evaluate this germplasm, through the turbulent research environment of intervening decades, has provided outcomes that can benefit growers and consumers of citrus for years to come.

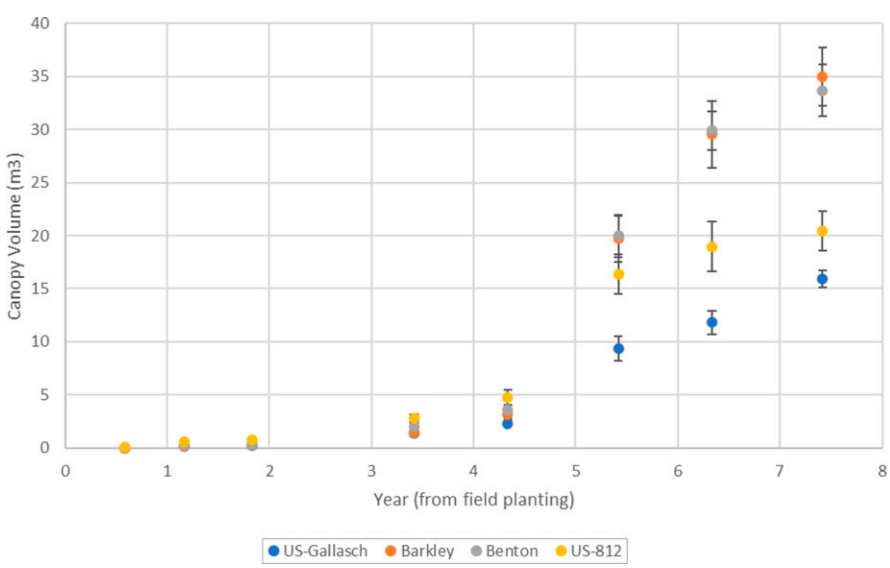

Fig. 3. Canopy development of 'Imperial' trees on 'US-Gallasch' during the first 8 years of field growth compared with three well-adapted control rootstocks (Wallaville, Queensland, Australia, planted 2016). Values to year 5 are based on tree height and width measurements and the equation of Wutscher and Hill (1995), and subsequent values are measured using LiDAR (GreenAtlas, McEvoy St. NSW 2015, Australia, www.greenatlas.com). Error bars represent standard deviation.

Etymology

The name 'US-Gallasch' has been chosen to reflect the combined efforts of scientists in both the United States and Australia in progressing this new rootstock toward release for commercial testing. The USDA pioneered the application of an intense selection differential for tolerance to *Phytophthora* and salinity, resulting in just a few hybrids from vast populations generated and screened over more than 20 years. Peter Gallasch was instrumental in preserving this material and assessing its value to citrus growers in salt affected areas of regional South Australia, efforts that were not adequately supported or acknowledged at the time.

Availability

A limited supply of pathogen tested budwood may be available upon written request

Table 4. Leaf chloride levels and visual salt damage of 16-month-old nursery seedlings of 'US-Gallasch', 'Troyer', and 'Flying Dragon' following 4 months of treatment with saline irrigation water (increasing incrementally from 1.5 to 11.5 g/L NaCl). Data extracted from Smith (2018).

Rootstock	Leaf chloride level (ppm)	Visual salt damage[i]
'US-Gallasch'	2.14 a	2.0 a
Flying Dragon	5.23 b	19.7 c
Troyer	6.22 b	13.0 b
Significance	<0.001	<0.001

[i] Rating scale 0 = no detectable damage 20 = necrosis and plant death.
Mean groups for significant analysis of variance within columns were by Tukey test at $P < 0.05$.

to the authors. Although this rootstock is highly apomictic and molecular markers are available, we still encourage the use of clonal material to propagate seed-source trees. Small quantities of seed may also be supplied, subject to availability and phytosanitary requirements. The definitive source tree of 'US-Gallasch' is located at Bundaberg Research Station, Queensland, Australia, with budwood from this seedling tree now also located with AusCitrus in New South Wales. Trees of this same accession (62-109-40) are likely to exist at Lindcove Research and Extension Center in Exeter, CA, USA and Loxton, South Australia; however, molecular confirmation (see Table 1) should occur before it is concluded that these are identical to 'US-Gallasch'. The accession held at Bundaberg went through two generations of seed production and has passed through a number of research programs since it was originally created at Indio in 1962. Likewise, the accession held at Lindcove was vegetatively propagated from material at Indio (Soost 1985) more than 40 years ago. For these reasons, the material used and published in previous QDPI research has always been referred to as '14Q055', which can now be considered a superseded synonym of 'US-Gallasch'.

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