Journal of the American Pomological Society 73(2): 129-138 2019

American Fruit Explorers:

Walter Tennyson Swingle: A Relentless Intellect that Transformed American Pomology

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Additional index words: Citrus breeding, citrus taxonomy, dates, historic, plant explorer, University of Miami, USDA

Abstract

Walter Tennyson Swingle grew up outside of Manhattan, Kansas, attended classes at Kansas State Agricultural College (now KSU) at 15, and when he graduated at 20 he had already published 27 scientific papers in plant pathology, plant breeding and genetics. Swingle joined the United States Department of Agriculture (USDA) in 1891, and was sent to Florida to investigate diseases in orange trees. He established a USDA laboratory and began a comprehensive program to breed disease- and frost-resistant citrus. He proposed testing all known wild relatives for disease-resistance and other advantageous traits that could be introduced to improve citrus. While conducting comprehensive studies of the comparative anatomy and systematics of the orange subfamily, he discovered some new species and several new genera. His breeding originated several new categories of citrus: the tangelos, citranges and citrumelos (now critical as rootstocks), and many other intergeneric hybrids. He was an early advocate for permanent, living collections of economically important plants and their close relatives. In 1897-98, in collaboration with David Fairchild, he established the USDA's Office of Foreign Seed and Plant Introduction, and new plant introduction research facilities were set up in Miami. He was a champion for ensuring that introduced plants were disease and pest free. He conducted plant exploration, mainly in countries surrounding the Mediterranean, and among many other accessions introduced date palms, figs, table grapes, and 'Clementine' mandarins. He also brought in the *Blastophaga* wasp to pollinate Smyrna-type figs. After his retirement from the USDA, Swingle moved to Miami in 1943 and completed his treatise on the taxonomy of the citrus subfamily. "Even in his retirement, Swingle inspired a generation of students with his knowledge, curiosity of nature, and insights into plants. His simple advice to students was 'Look and look, again and again,' words still relevant today".

Introduction

The contributions of W.T. Swingle were so many and varied that a linear temporal presentation of his career and life is virtually impossible. This summary is divided into several narrative threads: his early life, through college, USDA employment, plant collections, and retirement.

Early Life

Walter Tennyson Swingle (later "Tenny" to his friends) was born in 1871 in Canaan Township, Pennsylvania. Due to poor soils at their Pennsylvania farm (Bartlett, 1952), his family moved to Kansas in 1873 and he grew up on farms outside of Manhattan (Venning, 1977). By the age of nine, Swingle had "sopped up the entire curriculum" of his one-room schoolhouse (Venning, 1977). After this, he was taught at home by his mother and helped with farm chores and explored the local plants. "If nobody could tell him what (the plants) were, he made up names of his own…. When he found out you could look them up, he stopped by the college and obtained a copy of Gray's Manual of Botany… and became highly proficient in systematic botany". (Venning, 1977)

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Fig. 1. Swingle in 1893, reading in his lab at USDA Washington, and "just back from the citrus region of Florida". Note the poster on the wall behind him, describing the need for quarantine laws regarding importation of fruit trees. Photo: Courtesy of the National Agricultural Library.

In later life Swingle considered his unorthodox schooling a major advantage, arguing that formal schooling made children too regimented and standardized in their thinking (Bartlett, 1952). His intellectual stimulation also included frequently attending debates in Manhattan, KS, with one of the few topics he recalled being "Resolved, that wealth has more influence upon the central government than labor" (Venning, 1977). Presumably, these discussions contributed to his intellectual rigor.

Swingle at College

At 15, Swingle began attending classes at the Kansas State Agricultural College (KSAC) (now Kansas State University). He was recognized for his lively intellect, asking questions previously unasked such as "How long can a weed seed lie in a field before it sprouts?" "Why don't we try to get rid of weeds by introducing their diseases?" "If we tried to hybridize corn, when is the silk receptive to pollen? How long does it stay receptive?" (Venning, 1977)

David Fairchild, whose father was president of the college, first met Swingle when Swingle presented a paper on cereal crop rusts at the age of 16. Fairchild later stated, "It gave me my first insight into the great intellect of Swingle. It was from him that I first heard the word "bacteria", and with it he opened for me the door into the world of microscopic organisms" (Venning, 1977). Due to his taxonomic skills, at 17, Swingle was appointed assistant botanist at the experiment station and was a founding member of the Gray Memorial Botanical Association (Bartlett, 1952). By the time he had finished his B.S. degree in 1890 at age 20, Swingle had published 27 papers, including six as the sole author, in the then new and exciting fields of plant pathology, plant breeding and genetics (Venning, 1977). He was conferred an M.S. by KSAC in 1896 and the title Doctor of Science in 1922, based not on formal training, but due to his vast contributions to science (Cooper, 1995).

Employment by USDA

In 1891, Swingle was offered a position as Special Agent of the Division of Vegetable Pathology (Nixon, 1952) with the newly formed USDA, on the recommendation of David Fairchild (Fig. 1). He was so young at this point that his parents had to give their

permission for him to accept the job (Bartlett, 1952). Swingle was given a starting salary of $1,400.00 (Cook's Info. 2012), about $35-40K in current dollars.

In July of 1891, Swingle was sent to Eustis, Florida to examine orange trees, with the charge of developing strategies to fight several new diseases affecting orange groves, and he set up a lab there, working with growers to understand their problems. Shortly after arriving, Swingle wrote to Fairchild that "orange trees looked something like oaks, but had orange-colored fruits hanging from their branches." (Bartlett, 1952). By 1894, sooty mold had been controlled; lemon scab had been checked; and diseases such as blight, foot rot, and dieback studied with much new information (Venning, 1977).

In 1893 Swingle and H.J. Webber began a citrus breeding program to breed new disease-resistant citrus trees, as a longer-term solution. The program was founded on the concept that resistance traits from wild relatives would be key (Venning, 1977). Coupled with this, he had an early understanding of the need for phytosanitary standards in plant movement. Photos of Swingle at his Washington DC lab show a poster behind him from the California Fruit Growers' Convention Nov. 1891 at which a proposal was submitted demanding that state and federal officials enact a law to prevent importation of trees infested with insects and fungal pests (Fig 1). Later he developed elaborate measures to control citrus canker and quarantine procedures to prevent the disease Tristeza from being introduced through citrus budwood (Bartlett, 1952).

After the devastating freeze in the winter of 1894-1895, Swingle (as well as Fairchild) took leave from the USDA and went to Europe for further scientific training. He studied in Bonn in 1895-96 and Leipzig in 1898, with pioneers in plant physiology.

Fig. 2. W.T. Swingle collecting and eating citrus with T. Ralph Robinson in 1941 around the time of his retirement from USDA. Photo: Courtesy of Fairchild Gardens Archives.

Making his mark in citrus breeding

Swingle was in the small group of scientists hired to be the first USDA plant breeders (Griesbach, 2013) at a time when the benefit of "plant breeding" was still an innovative concept. Due to freezes early in their citrus breeding efforts (Webber and Swingle, 1905), in 1907-1909 Swingle directed crosses made by Frank Savage using *Poncirus trifoliata* as a source of cold-hardiness. Resulting plants included 'Carrizo' (Navel orange × *Poncirus*; Hodgson, 1967), now the most important citrus rootstock in California (2nd in Florida) and 'Swingle' ('Duncan' grapefruit × *Poncirus*; Hutchinson, 1974).), the most widely used citrus rootstock in Florida. But the freeze-resistant scion types envisioned have been slow in coming. Even though *Poncirus* and hybrids taste absolutely terrible for the first few generations, USDA citrus breeders were persistent and now have produced "near commercial fruit quality" *Poncirus* hybrids which show good tolerance to HLB, are using them aggressively as parents, and have released US SunDragon which is 1/8th *Poncirus*.

Informed in part by his citrus work at the USDA, Swingle coauthored an early monograph with H.J. Webber (Swingle and Webber 1897) detailing the value and use of hybridization in plant breeding and their characteristics.

Further cold-hardiness breeding was conducted using a kumquat parent in 1922, giving rise to 'Eustis' and 'Lakeland' limequats. Swingle's pioneering efforts at wide citrus hybridization also created other new citrus categories. The most economically important are the tangelos, produced by crossing grapefruit with tangerine (Cooper et al., 1962). At one time the 'Orlando' tangelo was widely grown in Florida, with over a million trees propagated in Florida alone since 1982, but it has fallen out of favor in the last few decades (Stover, 2013). Its sister cultivar 'Minneola' has enjoyed a steady interest with even more trees propagated and continues to be grown in Florida (DPP, 2016) due to its exceptional flavor. To underscore the brave new world of citrus breeding implemented by Swingle, these two cultivars are reported ("from Swingle's unpublished notebooks") to have been produced from seed of the same fruit crossed with pollen from a single flower (Cooper et al., 1962). Both tangelos have been widely used as parents for subsequent cultivars.

Numerous novel interspecific and intergeneric hybrids were produced, most of which are now curiosities rather than useful cultivars, and many have been lost. The categories were all given common names that are portmanteaus of parental common names (Citradias, Citrandarins, Citranges, Citrangedins, Citrangequats, Citrumelos, Citrumquats, Eremolemons, Eremoradias, Eremoranges, Faustrimedins, Chandan's, Lemandarins, Lemonines, Oramons, Orangequats, Orangelos, Procimequats, Segetranges, Tangemons, Tangors) (Cooper et al., 1962; Swingle et al., 1931; Swingle, 1943a)

He is also considered to be the breeder for 'Murcott' (Hodgson, 1967) which had been the most important mandarin hybrid cultivar in Florida until its extreme susceptibility to huanglongbing caused its virtual elimination. Swingle also introduced the original seedy 'Clementine' (GRIN Global, 2018), which is in the pedigree of many mandarin hybrids actively grown today. He maintained his interest in citrus and citrus breeding throughout his life (Fig. 2).

Champion of plant exploration and germplasm conservation

In 1897-98 Swingle and Fairchild established the USDA Office of Seed and Plant Introduction (Venning, 1977). Recognizing the need for genetic diversity in crops and the risks of growing them in monocultures, Swingle was an early advocate for permanent, living collections of economically important plants and their close relatives. In support of this, he passionately argued that the Florida citrus industry, based on only a few varieties, was at great risk from the in-

troduction and spread of a severe disease (Bartlett, 1952). This idea was the genesis of the National Germplasm Repository System; which currently consists of 19 genebanks distributed throughout the US and Puerto Rico.

With his colleague H. J. Webber, Swingle developed plans in 1897 to establish a subtropical laboratory, still operated by the USDA/Agricultural Research Service as a research station and genebank in Miami at Chapman Field. This was the site of the first U.S. Plant Introduction Station. They were joined by Fairchild in 1898 and the trio were so enthused by the tropical diversity that they vowed to return to Miami in retirement to work together studying tropical plants (Venning, 1977).

"Swingle was truly prescient in using wild relatives of citrus in breeding or as rootstocks. He proposed testing all known wild relatives for disease-resistance and other advantageous traits that could be introduced to improve citrus. This led him into his comprehensive studies of the comparative anatomy and systematics of the orange subfamily (see Swingle, 1943b) completed during his extraordinarily productive 'retirement' at the University of Miami" (Whitlock, 2009).

In agreement with Liberty Hyde Bailey, Swingle proposed introducing all citrus relatives to a disease-free island in the Sea of Japan and taking material from this repository to test against all major citrus diseases (Venning, 1977).

Swingle the plant explorer

"In 1898 the USDA Office of Pomology paid my way to Europe to make a collection of good table grapes that might work out in California." (Venning, 1977).

His explorations abroad continued for the next two years, traveling to France, Sicily, Italy, North Africa, Greece, and Asia Minor. "Before starting out on his travels, he and Fairchild drew up plant lists. Swingle was to emphasize crop plants suitable for the South, especially for the Southwest. The list included Egyptian cotton, melons, wine and raisin grapes, citrons, olives, pistachios, Smyrna-type figs, and the like..." (Venning, 1977). Fairchild and Swingle envisioned a high-quality table/desert date industry for the US and sought the cultivars needed to achieve this. Swingle studied the varieties and cultural practices used in North Africa and published the first comprehensive monograph on date varieties and their culture (Swingle, 1904), which is his most comprehensive publication after the treatise on citrus taxonomy (Bartlett, 1952).

He introduced the 'Medjool' and 'Deglet Noor' among many cultivars, and these two remain the most important dates in the US. Importation, establishment and quarantine of the date offshoots makes a compelling read, with many details that would never be included in a modern account.

One of the tasks that Swingle took on was understanding why Smyrna figs would not crop in California. In his studies he learned of the peasant farmer practice of hanging caprifigs in the Smyrna trees, which was dismissed by scientific authorities as a superstition (Venning, 1977). Swingle introduced the Blastophaga wasp pollinator (*B. psenes*) of Smyrna figs and their caprifig hosts (Swingle, 1943a) from Algeria in 1898 (Nixon, 1952), ensuring the success of fig culture in the United States

Swingle's key roles in establishing a U.S. date industry

While in Algeria, Swingle became interested in the date palm. 'Deglet Noor', one of the best date varieties from Algeria had been first introduced to the US in 1890, but that introduction was a failure (Toumey, 1898). In 1899, Swingle visited oases in the Algerian desert, to select good specimens of 'Deglet Noor' date for introduction into the desert southwest of the US. Unfortunately, all six imported offshoots died due to improper handling (Nixon, 1952). After visiting with Professor J.W. Toumey, director of the Arizona Experiment Station, Swingle returned to Algeria in 1900, determined to

import enough offshoots to introduce date culture to the US. Swingle (1947) and Cooper (1995) provide a detailed and colorful description: "The French president of a company marketing dates wrote a letter asking that his employees do everything possible to help him. One accompanied Swingle into the desert 100 miles south of Biskra. It was mid-May and the weather very hot, so they traveled by night and slept in the day in thick walled forts called "Bordjs". They reached a salt lagoon covered with a crust of salt, and dates surrounding it were growing in salty soils irrigated by artesian water at 0.5-0.6% salt. During the heat of the day deceptive mirages could be seen across the lagoon, which Swingle described as being similar to the Salton Basin in the Coachella Valley. Swingle bought 447 date offshoots, mostly of 'Deglet Noor' and 'Rhars' varieties, trimmed them, and prepared them for travel on a camel caravan to Biskra. Unfortunately, the area was not yet pacified, so the French military government seized all the camel caravans in the area to forestall a rebellion. However, fifteen or twenty camels were found, and the offshoots made it to the railhead in Biskra in two days. The offshoots were then moved to the port in Algiers, packed in wooden crates filled with sphagnum moss, shipped to New Orleans, and then transported by rail to Arizona." Most were established at the Arizona Agricultural Experiment Station date introduction garden in Tempe, AZ and 75% survived (Swingle, 1947, Hilgeman, 1972). This was the first successful large-scale importation of offshoots of superior date varieties into the United States (Nixon, 1952).

Importation of the 'Medjool' date variety was also directly due to Swingle. In April 1927, Swingle was invited to visit Morocco to study the devastating "Bayoud" disease *Fusarium oxysporum f. sp. albedinis* W.L. Gordon (Swingle, 1945). While waiting for the arrival of French military protection (as the area was still not completely pacified), near Boudenib in Southeastern Morocco, Swingle befriended a local ruler who allowed him to buy six large and five small 'Medjool' offshoots from an apparently Bayoud-free date garden. These offshoots were shipped to Washington, DC where they were found to be free of the disease but were nonetheless fumigated with hydrogen cyanide (Swingle, 1929). However, quarantine regulations still required that the offshoots be planted in a state with no date palms! Therefore, they were transported to southern Nevada by railcar and planted on the Fort Mohave Indian Reservation, under the care of an elderly tribe member and his wife. Although two of the small offshoots died because they were dug up by the caretaker's dog, the other nine survived and produced numerous offshoots themselves. Once the quarantine requirements were fulfilled, the surviving nine original palms plus 64 offshoots were moved to the US Date Gardens station in Indio, CA in 1935 (Thackery, 1952). Those nine offshoots are the source of the entire 'Medjool' date industry in California and Arizona which comprises about 3500 ha. (Wright, 2019).

Swingle was also directly or indirectly responsible for all other experimental importations of date offshoots made by the USDA (Nixon, 1952).

Swingle was certain that the Salton Sea area would harbor a thriving date industry, and at his insistence, in 1904, USDA established an experimental date garden near Mecca, CA in collaboration with UC, which subsequently moved to Indio, CA in 1906. For many people Swingle is best known for introducing date palms into the US and he even "owned and operated" a date garden in Indio, CA.

Plant exploration and germplasm conservation

The USDA Germplasm Resources Information Network (GRIN Global, 2018) lists 2054 accessions with W.T. Swingle as the collector. In the original PI records some specify "collected by", others "received through", and others "donated by" W.T. Swingle. It looks like some of the "received

through" accessions were sent to Swingle in Washington, DC rather than being collected by him in the field.

The list includes alfalfa, asparagus, beans, beets, brassicas, cannabis, carrots, coffee, cotton, cucumbers, flax, hops, lentils, lettuce, melons, ornamental and timber trees, onions, peas, peppers, potatoes, rice, source plants for medicines and spices (quinine, cumin, oregano), soybeans, tomatoes, watermelons, wheat, wild crop relatives, as well as fruit and nut crops ranging from almonds, apples, bananas, blueberries, citrus (179 accessions), chestnuts, dates (270 accessions), figs, grapes (100 accessions), guavas, hazelnuts, jujubes, litchi, mulberries, passionfruit, peaches, pears, persimmons, pineapples, pistachios, raspberries, strawberries, and walnuts.

Of the 2054 accessions, fewer than 84 are not "historical", providing yet more evidence for the value of the National Plant Germplasm System to conserve genetic resources. There are 16 accessions introduced by Swingle that remain at the National Clonal Germplasm Repository for Citrus and Dates (Robert Krueger, personal communication) and unfortunately those in the citrus collection cannot currently be distributed due to the quarantine related to huanglongbing.

Personal life and some "details that demonstrate his humanity"

As a teenager "the Swingles were not as bent on moral reform as were their fellow Kansans." When Kansas went "dry" in 1880 (it stayed "dry" until 1949), "Pa and I gathered grapes in the woods, and he made us wine." (Venning, 1977)

Swingle went on leave in July 1898 and spent the next year at the University of Leipzig. While in Europe, he met his future wife, Lucie A. Romstaedt, who was his French tutor and they married in 1901. Interestingly, his widowed father remarried, and a son was born in 1899, Charles Fletcher Swingle, who also became a successful botanist and plant explorer (Cook's Info, 2012).

It is reported that the "first Mrs. Swingle was a stylish socialite, expecting parties, furs, jewels, and other manifestations of high living. She accompanied him on his travels, staying in grand hotels, and they soon became deeply in debt." "They ordered vintage wines and fruit out of season". She died of typhoid in 1910, and after her death, Swingle lived frugally to pay off his debts (Venning, 1977).

In 1911 Swingle became reacquainted with botanist Maude Kellerman, daughter of his old professor at KSAC, when she came to Washington, DC. In October of 1915 they married and subsequently had four children (Bartlett, 1952).

An Asian interest that extended beyond plant collection (extracted from Bartlett, 1952; Venning, 1977; and Whitlock, 2009)

Swingle first became interested in Chinese literature through reading about the history of citrus cultivation, and many of his accessions were collected from the Far East. Swingle learned to speak and read Chinese and oversaw the translation of many works of Chinese literature, and later extended this to literature from Japan, Korea, and Mongolia.

During his travels, he was given a budget and authority to purchase works he deemed valuable, many but not most related to his work at USDA. Between 1915 and 1935, Swingle assisted the Library of Congress (LOC) to obtain over 100,000 volumes, a critical contribution to making it a world class collection. He wrote the Annual Reports on Far Eastern accessions from 1916 to 1928 for the LOC. His reports essentially constituted a history of Chinese science, giving many American botanists and agriculturists a first look at this important body of knowledge.

Other intellectual pursuits

As a student at KSAC, Swingle developed a hot water treatment that prevented the fungal disease bunt in wheat (Bartlett, 1952). He also recognized that little scientific work on plant science was underway in the US

and resolved to learn German so he could access the original papers. It is reported that he learned German not through formal courses, but from a German immigrant who was responsible for feeding the pigs at KSAC (Bartlett, 1952). His proficiency at German was invaluable in his European studies. While in Bonn he worked with Strassburger, who theorized that chromosomes were carriers of heredity and Swingle conducted cytological studies which proved the existence of centrosomes in some plant cells (Venning, 1977).

In additional work during his career, he:

1) Occupied the Smithsonian Chair at the Marine Zoological Institute in Naples, Italy to continue studies of the cell (Venning, 1977) as "honorary custodian of algae" at the museum (The Smithsonian, 1899). His single publication on algae was published in that period (Swingle, 1896)
2) Developed a heat therapy method to divest date palm offshoots from scale insects to allow importation and demonstrated that 'Deglet Noor' will not ripen fruit unless bunches are thinned (Venning, 1977),
3) Made hybrids between *Phoenix* species and found that the seed, fruit characteristics and ripening time were affected by interspecies pollination: as a result, he proposed the term "metaxenia" to describe this phenomenon (Swingle, 1928, Nixon, 1928) and the concept caused an uproar in the scientific community (Bartlett, 1952).
4) Showed that citrus grown from nucellar seedlings were rejuvenated, likely due to seeds being freed of viruses - a benefit he termed "neophyosis" (Bartlett, 1952) - a trait of great economic importance today.
5) Invented improvements for the microscope and contributed to better understanding of cell structure (Nixon, 1952).

As administrator of a USDA bureau:

(source is Venning, 1977 unless otherwise noted)

Swingle was instrumental in the creation of the Bureau of Plant Industry and helped to formulate its early policies. "In those early years, his colleagues would refer to him as 'the Bureau hot bed' or 'the Plant Bureau incubator'" (Nixon, 1952). New ideas were constantly whisking around in his head (in fact, the saying became commonplace throughout the Bureau, "We'll never run out of ideas as long as Swingle's around."). "He was always impatient to try out his ideas and the department often had to decide whether to try to curb his enthusiasm or let him have his way at the risk of a fiasco." Dr. H.W. Webber once said that after two or three days of continuous association with Swingle, he (Webber) began to develop mental fatigue (Nixon, 1952). "Under his management the office budget was always spent before the year was out. He would cancel employees' vacations at the last minute, make spur-of-the-moment trips to California, Arizona, Florida, wherever, not knowing how long he would be gone; he would leave the staff to pick up and carry on without instructions, and then rage when he got back if they had not known all that he had in mind. At the same time, his superiors were storming at him for undertaking unscheduled projects, for not documenting methods and objectives, for running out of funds at midyear."

His later years at USDA

(extracted from Venning 1977)

Growers reported dissatisfaction with the profusion of new varieties generated under Swingle, not wanting "to bother with more than two or three standard varieties" and fearful that new releases would reduce the value of existing groves. Swingle argued that growers should be educated in their own interests, even if they were resistant. In the USDA, "He was saddled with administrative duties, to which he was ill-suited". In the view of his supervisors, his approach was disorderly and wasteful. USDA leaders in the 1930s were "staggered by the scope of his proposals", such as introducing all citrus relatives to a disease-free island in the Sea of Japan, to test against all major citrus diseases. A high-level review of USDA programs concluded

Swingle's efforts were uncoordinated and in a broad reorganization Swingle's Office of Crop Physiology and Plant Breeding was abolished, and he was assigned to the section of Seed and Plant Introduction in 1934.

In 1939, the USDA decided to move all citrus work to Orlando, FL. Over his protests, all Swingle's hybrids were hauled to Orlando, and planted with no irrigation. Most were lost.

His biographer Venning stated, "Swingle's career in one short phrase was an astonishing accomplishment, accompanied by increasing frustration. While growing up and while in college, he had never been confined within a planned, orderly, day-by-day routine; he had always had sizeable amounts of unorganized time for following up ideas, for spur-of-the-moment activities as his thoughts or interests led. He had no training in …. economic theory …, business or finance, nor did he ever take any interest in these subjects."

Fig. 3. Swingle speaking at an ourdoor lecture. Photo: Courtesy of Fairchild Gardens Archives.

Retirement and the University of Miami years

After his retirement from the USDA, which was compulsory at the age of 70, Swingle moved to Miami, joining David Fairchild as they had promised years ago.

In 1943 he was given a position at the University of Miami (UM). Swingle was given the title Consultant of Tropical Botany. He was provided with an honorarium, a travel allowance, an office, clerical and student assistance, an equipped laboratory, and status as a member of the faculty (Venning, 1977). At UM, Swingle completed his monograph "The Botany of Citrus and its Relatives of the Orange Subfamily" (Swingle 1943b) which remains the premier reference for the taxonomy, morphology, and anatomy of these plants.

Swingle continued to be highly productive at UM, interacting extensively with students and continuing in scholarly pursuits (Fig. 3). By the end of his career, his students compiled a bibliography of over 250 scientific articles he had written. "Even in his retirement, Swingle inspired a generation of students with his knowledge, curiosity of nature, and insights into plants. His simple advice to students was 'Look and look, again and again' words still relevant today." (Whitlock, 2009). He passed away in Washington DC in 1952.

Swingle's legacy

In addition to helping found USDA plant germplasm collecting and conservation, and the critical material he himself collected, Swingle is remembered in numerous ways. The most authoritative treatise on taxonomy of citrus and its relatives remains the monograph authored by Swingle in his later years (Swingle, 1943b). At UM today is the Swingle Plant Anatomy Reference Collection, several thousand digitized microscope slides of plant structures from tropical crops and their wild relatives. Many of the slides were prepared from plants that Swingle and his colleagues cultivated in the Miami area or obtained in their travels.

Swingle discovered dozens of new species

and new genera of the citrus family and is listed as the taxonomic authority. The genus Swinglea was named in his honor by E.D. Merrill (Bartlett, 1952). The most important citrus rootstock in Florida, from his own breeding program is called 'Swingle', from a cross he made in 1907 which was released in 1974 (Hutchinson, 1974). His biographer Bartlett (1952) summed up Swingle's career with the statement "Swingle was one of the most interesting and useful men of the brilliant foundation period of the USDA. His name deserves a high place in the honor roll of American botanists and humanists".

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