Stowaways and Invited Guests: How Some Exotic Plants Reached the American Southwest

Barbara Tellman
Water Resources Research Center, The University of Arizona
350 N. Campbell Avenue, Tucson, AZ 85721

The Earliest Exotic Plant Introductions

The history of exotic plant species introduction goes back many thousands of years. The earliest recorded plant importation comes from ancient Egypt about 1470 B.C., when Queen Hatsheptsut ordered frankincense trees (*Boswellia* sp.) and other plants from Punt on the East African coast. The Persians, Greeks, Romans and many other ancient civilizations imported plants.

For more than 2000 years Native American peoples farmed with plants which they domesticated such as cotton, squashes, agave, and beans and spread them far from their original location. Agriculture was an important component of the Spanish conquest. Columbus brought with him on his second voyage not only horses, cattle, sheep, goats, swine and domestic fowl, but also plants of lemons, bergamots, melons, orchard fruits and sugar cane. In 1493 the first American plants were sent back to Spain. With the spread of the missions, crops gradually moved up from Mexico. In 1763 Juan Nentvig, a Spanish soldier and explorer recorded a lengthy list of herbs and edible plants growing in Sonoran desert mission gardens.[1]

As early as the 17th century European scientists were traveling the world over seeking new species of plants and bringing back specimens, seeds and cuttings. Plant hunters had to find ways to keep plants alive during long sea voyages where fresh water was at a premium. One plant explorer lost several years work when his plants were watered with sea water. Development of a portable greenhouse increased the success rate enormously. Some 6,746 exotic plants were introduced to England during the 59-year reign of King George 111, who died in 1820. It was during this period that Europeans and later Americans built enormous greenhouses for their collections and developed systems for seed and plant distribution. A major U.S. grower was William Hamilton, who had a 300-acre estate in Philadelphia and was the first to grow Tree of Heaven in the United States.[2]

As settlers (often immigrants from other lands) moved west, they took favorite seeds and cuttings with them. With the arrival of the railroad in the Western United States, it became easy to transport plants and young trees. People could place orders with mail order nurseries from California to the East Coast. The great age of exotic plant introduction in the West had begun.

Introduction Histories of Nine Species

Filaree (*Erodium cicutatium*)

Some introduced plants actually preceded the Spaniards. Ships that docked off the California coast inadvertently brought seeds in their ballast, packing materials or on the fur of animals. Plants established near the shore were spread by birds on the great migratory flyways. In this way, the plants spread inland years before the people did. Filaree is a good example of this. It was found in California when the first missions were built and was plentiful enough to be incorporated into the adobe bricks. George Hendry spent more than two decades making detailed studies of plant content of adobe brick and found 3 species whose introduction preceded the Spanish, *Erodiuni cicutarium, Rumex crispus* and *Sonchus asper*. He inferred that these preceded Spanish settlement because they appear in the earliest bricks made before 1769, but without remains of agricultural crops which were only present in adobe bricks at these and other sites much later. These findings were consistent in sites separated in time and space.

In March 1844, explorer and surveyor Captain John Fremont found filaree as he came down from the California foothills towards the valley. He wrote "… we discovered three squaws in a little bottom, and surrounded them before they could make their escape. They had large conical baskets, which they were engaged in filling with a small leafy

plant (*Erodium cicutarium*) just now beginning to bloom and covering the ground like a sward of grass." By April 12 he had descended into the valley and again reported filaree saying "instead of grass the whole face of the country was closely covered with *Erodium cicutarium,* here only two or three inches high.

Many farmers planted filaree for forage. Filaree is now common throughout the Southwest in riparian areas, vacant lots, and elsewhere.[3]

Bermuda Grass (*Cynodon dactylon*)

Bermuda grass was considered a sacred plant in the Veda of ancient India, where it was called "the preserver of nations" and the "shield of India," because of its forage value. It also has a long history in African medicinal lore and was probably introduced to Africa on Arab merchant ships before 500 A.D. It is now found world-wide and on every continent except Antarctica.

Georgia Governor, Henry Ellis, introduced it to Savannah in 1751. (Actually his neighbor, a man we know only as Mr. C., an ardent plant collector who frequently traveled to distant places such as Bermuda probably gave it to the Governor). It spread rapidly and within 50 years a botanist found it "frequent on roadsides and cultivated ground" in the East and Southeast. In 1856 it was sold in San Francisco for $5 a flat. By 1880 it had become a troublesome weed near San Bernardino, in Southern California. Rivers and canals were ideal dispersers, as the seeds spread rapidly in water. By 1911 it had become a serious problem as it invaded fields and canals.

Extension agents recognized it as a problem before 1911, but believed they had found a way to control its spread, writing in a special bulletin "Following the practice outlined above, we have ceased to dread Bermuda grass at Yuma, finding it not only possible but practicable to keep it in subjection." It is now found through the lower elevations of Arizona.[4]

Johnson grass (*Sorghum halapense*)

Johnson grass first appeared in Southern states under the names Guinea grass, Means grass, Bankruptcy grass and many other names before 1840. The South Carolina Means family played a major role in its introduction. One family story relates that a relative, John Davis, brought back "fine Swiss watches packed in johnson grass seed." Another story says that John Means introduced it in contaminated hemp seed from Egypt shortly after the Revolutionary War. One of the Means daughters became Mrs. Johnson and moved to Alabama. In 1880 Herbert Post stated that he had managed the Johnson farm near Selma Alabama on which Johnson grass had been grown for 40 years. In areas where frost didn't kill it, it became a noxious weed, which could survive drought, grazing and even a little freezing.

The Arizona Gazette in 1890 wrote "In the last two years farmers in the Salt River Valley have been greatly annoyed by the appearance of Johnson grass on their ranches. The grass is far more of a pest to the farmer than is sour clover or fox tail grass (both introductions from the Old World) to a blue grass lawn. Investigation as to the cause of the grass spreading over the valley developed the fact that there are two ranches away up at the head of Salt River, above the Tonto Basin, which are covered with Johnson grass, and from these ranches the seed has been carried down by the water to the farms." It was easily available by mail-order.

One anonymous Arizona farmer did not succeed in preventing its spread in 1897. "Early this spring I observed a small patch [Johnson grass] in the comer of my orchard and immediately sent a man to dig it out. That patch has been dug out 4 times this season and it is now about 3 times as large as when I first began to tamper with it." In 1914, the Reclamation Service had no better success when it bought 2,000 head of sheep to graze the ditch banks. The grass still thrives and is considered a major problem today throughout Arizona below 6,000 feet elevation. When under stress, such as frost or drought, the grass can become toxic to cattle and other wildlife.[5]

Tree of Heaven (*Ailanthus altissima*)

Father Pierre Nicholas de Chevron d'Incarville was sent to Peking in the 1740s as a Jesuit missionary. For ten years he labored on both his religious mission and his personal mission to introduce hitherto unknown plants to Europe. Because of China's strong isolationist policies, seven years passed before he was allowed to travel to areas where plants could be collected. Shortly before his death, he entrusted some seeds to a confidant in a Russian caravan, making the long trek across Siberia and finally to England.

From those seeds Philip Miller grew the first successful European *Ailanthus* trees in all of Europe in 1751 at the Chelsea Physic Garden. William Hamilton's plantings of offspring of those trees on American soil in 1784, were viewed as "great novelties from a far distant land." Soon they became common throughout the Eastern U.S. About

75 years later the tree was introduced far more easily to the West Coast by Chinese gold miners who planted them along California streams. It has naturalized in California, Arizona, New Mexico and elsewhere and is rapidly becoming a problem riparian species.[6]

Saltcedar (*Tamarix ramosissima*)

Saltcedar appears in the Bible under the name Esh el, and in ancient Arabic literature as Asul. It was valued for its manna, a sweet exudate produced by a scale insect. There has been much confusion and uncertainty about the proper nomenclature. Were *T. gallica, ramosissima, chinensis* and *pentandra* the same or different? As one botanist said "There is probably not another genus of plants as well known as the tamarisks in which the species are so poorly understood …" Thus, early references to specific species of *Tamarix* are suspect. The most common 19th century distinctions were between French, German and African tamarisk. "French tamarisk" was probably generally *ramosissima.*

Although the original collector is unknown, (it is common throughout areas frequently visited by Americans) several species were advertised by U.S. nurseries by the 1820s. The Old American Nursery of New York offered French tamarisk for sale in 1823 and Bertram's Botanical Garden and Nursery listed French and German tamarisk "much admired" for 37 cents. By the 1830s many nurseries were offering *Tamarix*, but seldom made clear which species they had. The U.S. Department of Agriculture grew *Tamarix* at the National Arboretum in Washington and in 1868 reported that six species had become established there. It released *"Tamarix Pentandra"* for cultivation in 1870.

It escaped cultivation in 1880 in Utah and in 1897 in Texas. In 1901 it was "common in river bottoms," from the Salt River in Arizona." The Arizona Agricultural Extension Service recommended several species of *Tamarix* for landscaping. *Tamarix* naturalized most rapidly from the 1930s to the 1960s, most often in areas disturbed by human activity, such as upstream and downstream of dams.[7]

Early botanists had no clue that the species would become a problem. Thomber's bulletin recommended 5 species, including the one that has become so invasive, saying "These plants appeared to succeed almost everywhere, though their growth was most robust in alkaline soils ... they are interesting because of their notable adaptability to arid and semi-arid regions ... They are propagated readily from seeds and cuttings. No difficulty is experienced in starting them to grow … " These were the very qualities that made it so much of a problem.

Russian Olive (*Elaeagnus angustifolia*)

The Russian Forestry Department conducted extensive research on *Elaeagnus* and in 1887 published a pamphlet in which the tree was considered "a valuable tree for hedges in south Russian steppes. For snow-breaks along railroads I plant it where stock would kill other trees, as it is not browsed by stock. When I cut it down to the ground, the fifth year, a great mass of strong sprouts are produced which attain a height of seven feet the first year and are armed with long thorns. Rabbits, as well as domestic animals, do not attempt to go through such a hedge and it is shunned by various insects … "

In the late 17th Century, Prussian Mennonites migrated to south Russia seeking religious freedom. Less than 100 years later, again under religious persecution, they migrated to Canada and the northern United States. A small group settled in South Dakota, bringing with them not only their religion, but many crops and farming practices, including Russian olive. In 1901 N.E. Hansen, of the South Dakota Agricultural Extension office traveled to Russia and experimented with it extensively and recommended it highly as a drought, animal, and frost tolerant ornamental plant in 1901. He said, "As a hedge it will turn any stock that Osage orange will. Horses or cattle will not attempt to go through it, and it does not sap the ground like Osage orange." It was easily available in South Dakota nurseries by 1900.

In Utah and Arizona Mormon communities, it was widely used as a landscape plant after 1900, with cuttings passed from one community to another by plant lovers such as W.H. Crawford of St. George, Utah, who introduced hundreds of plant species in the Virgin River area. The San Juan River in SE Utah is now lined with almost solid stands of Saltcedar and Russian olive, with some Camelthom. Very few natives are left except for willows.

Tumbleweed (*Salsold kali*)

Another introduction to South Dakota from Russia was tumbleweed, probably brought by the same Mennonite farmers. One of their crops was flax, which did not develop into a major agricultural crop, but planting flax did have a lasting effect, as the seed was contaminated with tumbleweed, also called "Russian thistle," "Wind Witch," or "Leap

the Field." It first appeared in Bon Homme in southeast South Dakota. It spread from there within ten years to neighboring Nebraska. The Nebraska Extension Service published a bulletin in 1892, with a 10-point plan for fighting the weed, including the last directive to familiarize " … every child in the public schools, with the appearance of this pest in order that he may destroy it wherever he finds it." It became a noxious weed so quickly that its spread has been carefully documented.

It reached California and Oregon on the west and Minnesota and Ohio to the east by 1895. An 1898 Arizona Agricultural Bulletin reported that "there is no direct evidence that this weed has as yet found its way into Arizona," but it did quote a report from the Philadelphia Ledger "Russian thistles, a patch of which has flourished for some time near Whipple, Arizona have overgrown well trodden paths there and made them impassable either for man or animals" and warned farmers to be alert for its appearance. Within a few years it was common.

The newly built railroad was an ideal vehicle for spreading tumbleweed throughout the West and tumbleweed's early distribution pattern shows it moving outward along railways and roadways. In at least two documented cases, new colonies were established after train wrecks in which wheat cars were overturned. Wind was also a good dispersal method, especially on the Great Plains with its high winds traveling for miles. One 19th century farmer claimed to have tagged a plant and within 24 hours found it had traveled 60 miles.

According to an 1891 USDA study, the form of tumbleweed in the U.S. was for more troublesome than its counterpart in Russia where it could be found mingled with wormwoods, sages, mulleins, true desert thistles and a multitude of other plants. Along roadsides there, the plant was not allowed to ripen. In southern Russia the plant did cause problems and severe measures were taken to protect sugar beet fields. In the United States, however, no such measures were taken. By 1894 it was estimated to have caused over $2 million in damages to wheat fields in the Great Plains states. A U.S. Congressman proposed spending $1 million to eradicate the plant before it would get farther established, but the bill was defeated by State's rights advocates who believed this was a job for state and local governments.[8]

Camelthorn (*Alhagi camelorum*)

While it is tempting to relate the introduction of this legume to Beale's 1850 great camel expedition from Texas to California, and theorize that it accidentally came on the fur of those camels, there is no evidence that it entered Arizona or California before the twentieth century.

In the 1890s, University of Arizona horticulturalist, Robert Forbes, and others introduced dates from northern Africa to California and Arizona. The survival rates were very low during the long ship voyages and land-journeys. A new packing method developed by Walter Swingle, using local plant materials, brought the survival rate up to about 90%, but apparently was also ideal for dispersal of weed seeds, among which was *Alhagi*. Swingle described his new method in 1898: "The awkward wooden tub method was eliminated in favor of wrapping the roots of offshoots in cocoons of damp moss or palm fiber. The relatively light plants were then hauled by camel over 90 miles of desert to the town of Biskra where they were ... loaded into a special railroad car for another journey of over 200 miles to Algiers ... " just the beginning of a long journey.

Camelthorn probably also came in alfalfa seed from Turkestan. Alfalfa was a prime source of weeds. N. Wykoof of Napa Valley, California wrote in his diary: "In the winter of 1854, I sowed 4 acres with alfalfa or luceme, as it was then called, seed brought from Chile. As far as I know, it was a part of the first parcel of seed brought into this country. My sowing proved so foul with weeds that I plowed it up and did not resow until 1864."[9]

Camelthorn spreads both by seeds carried in water and vegetatively. It quickly became a pest in the date-growing areas of California and Arizona, and later spread to the Gila River and as far north as the San Juan River in Utah. It was listed as a noxious weed in California, but eradication efforts were successful and it was delisted by the 1940s. It was listed as naturalized near Gillespie Dam along the Gila River in 1940, and can still be found there along irrigation canals today, downstream from an abandoned ranch with many old palm trees as well as alfalfa fields. It recently reached the Grand Canyon.[10]

Buffel Grass (*Pennisetum ciliare*)

Our most recent invasive plant introduction is Buffel grass. In the 1940s the Soil Conservation Service (SCS) brought it to the United States from the Turkana Desert of Kenya (where it was adapted to grazing by large herds of about 30 species of ungulates), as part of a major plant introduction program. This plant may not be familiar to you, but it is a serious pest in Sonora, Mexico and southern Arizona. It was formally released from the SCS nursery in San Antonio in 1946, as a forage crop for semi-tropical and tropical areas of the southern U.S. and Mexico. The

plant was found to be cold-hardy up to about 3000 feet elevation in Arizona. Attempts begun in 1983 to develop a cold-hardy strain from South Africa were dropped by SCS in 1991 due to lack of interest and increased environmental concern. Mexican ranchers have enthusiastically replaced thousands of hectares of Sonoran Desert vegetation with this invasive grass, which can now be found throughout southern Arizona and northern Sonora where winters do not get too cold. The plant thrives on fire. In some areas of Sonora, fires have increased many-fold and native vegetation has usually lost out to this aggressive grass, which is well adapted to fire. Cacti and other native plants have been almost eliminated from some areas of Sonora.[11] Buffel grass is common in vacant lots, roadsides, and many other places in Tucson, Arizona.

Some Ways to Find the Origin of Exotic Plants

The general history of plant introduction can be found in a number of books with names like "The Plant Hunters," all listed in the reference section. These books, however, generally deal with introduction of plants of which someone is proud - new food crops or landscape plants. There is virtually no mention in any of these books of the pest species. Several works have been written about weeds. But these books tend to concentrate on weeds that have become problems for agriculture rather than ones that became environmental problems. These works seldom really trace a plant to its first introduction. There is one very detailed study of plant introductions - nearly 800 pages long. Unfortunately, it was written by an Englishman and deals almost entirely with the former British Empire and only discusses the United States occasionally. All of these books are listed in my references section.

One of the best sources for California exotics is *The Introduction and Spread of Alien Weeds in California*, printed in 1940 by the California Extension Service. While it doesn't generally go into a lot of detail, it provides a good starting point.

The search for origins is somewhat like solving a mystery, especially if the plant arrived accidentally and took some time to become a pest. In some cases the introduction was well-documented, but in many other cases, the origins are seemingly lost in history. The people who brought Tree of Heaven to Europe and then the United States were very proud of their achievements and the introduction is well documented in the standard sources. Just the opposite is true of the introduction of tumbleweed. It became a pest so quickly that its spread was well documented because extension agents in more and more states spread the alarm. The records are easy to find in Bulletins and Annual Reports of the Agricultural Extension offices of Nebraska and many other states.

Often the trail points to Agricultural Extension. Old publications and annual reports contain a wealth of information. Unfortunately, they are seldom indexed, so one may have to just thumb through documents until something useful appears. The role of Extension, in conjunction with the U.S. Department of Agriculture was crucial both in introducing species and in fighting species that became pests.

For several years the *Proceedings of the California Weed Congress* featured the history of a specific weed. These histories are quite complete, but this feature only lasted a few years. Beyond these helpful sources, the search is much more difficult and often involves tracking down references in a sequence of articles. In the process, however, interesting bits of history can be uncovered.

It is very clear that until very recent times there was little or no thought to the negative aspects of plant introduction, although John Means had realized the potential more than a century ago. He bemoaned the fact that his family had introduced Johnson grass. He wanted to sell his farm, but "I will not move unless I can sell my lands for any price that would be an inducement for me to sell it, for the big grass has inspired such a terror that no one will even look at it. ... When the grass runs me off, then I will seek a home in the West ..."[12]

References

1. Spanish introductions (also see Footnote #4):
   Delaney, Robert W. 1987. The Modification of Land Use by Plant Introduction: The Spanish Experience. Journal of the West (July), 26-33.
   Hendry, George W. 1934. The Source Literature of Early Plant Introduction into Spanish America. Agricultural History 8(2). 64-71.
2. General historical sources:
   Crosby, Jr, Alfred W. 1972. The Columbian Exchange: Biological and Cultural Consequences of 1492. Greenwood Publishing Co., Westport, Connecticut. 268 p.
   Crosby, Jr, Alfred W. 1993. Ecological Imperialism: The Biological Expansion of Europe, 900-1900. Cambridge University Press, Cambridge. 368p.
   Hedrick, U.P. 1950. A History of Horticulture in America to 1860. Timber Press, Portland, OR. 634 pages.
   Jewett, Frances L. 1958. Plant Hunters. Houghton Mifflin. Boston. 230 p.
   Lemmon, Kenneth. 1968. The Golden Age of Plant Hunters. Phoenix House. London. 229 p.
   Lyte, Charles. 1983. The Plant Hunters. Orbis. London. 191 p.
   Mooney, H.A.; Drake, James A.(Eds.) 1986. Ecology of Biological Invasions of North America and Hawaii. Springer-Verlag, New York. 321p.
   Ridley, Henry N. 1930. The Dispersal of Plants Throughout the World.,L. Reeve and Co., Ltd. Ashford, Kent. 744 p.
   Tyler-Whittle, Michael S. 1970. The Plant Hunters. Chilton. Philadelphia. 281 p.
   Vale, Thomas R. 1982. Plants and People: Vegetation Change in North America. Association of American Geographer, Washington, D. C. 88p.
3. *Erodium* sp.
   Fremont, Capt. J.C. 1845. Report of the Exploring Expedition to the Rocky Mountains in the Year 1842 and to Oregon and North California in the Years 1843-44. U.S. Senate Document. Washington D.C. 242 & 253.
   Hendry, George W. 193 1. 'Me Adobe Brick as a Historical Source. Agricultural History . 53, 110-127.
   Hendry, George W. and M.K. Bellue. 1936. An Approach to Southwestern Agricultural History through Adobe Brick Analysis. In Symposium on Prehistoric Agriculture. University of New Mexico Bulletin #296. Albuquerque. 65-72.
4. *Cynodon dactylon*
   Anonymous. 19 10. Timely Hints for Farmers. Bulletin #88. Agricultural Experiment Station. University of Arizona. Tucson. 16 p.
   Mitich, Larry W. 1989. History and Taxonomy of Bermuda grass. In: 41 st Annual California Weed Conference. Sacramento. 181-187.
5. *Sorghum halapense*
   Anonymous. 1918. Johnson Grass Control. Bulletin #82. Agricultural Experiment Station, University of Arizona. Tucson. 16 p.
   Merrill, W.E. 1975. Invaders down the Salt. In One Hundred Echoes from Mesa's Past. Lofgreen. Mesa. 172-174.
   McWhorter, C.G. 1971. Introduction and Spread of Johnson-grass in the United States. Weed Science 19, 196-500.
6. *Ailanthus altissima*
   Spongberg, Stephen A. 1990. A Reunion of Trees. Harvard University Press. Cambridge. 270 p.
   Swingle, Walter T. 1916. The early European History and the Botanical Name of the Tree of Heaven. Journal of the Washington Academy of Science 6:490-498.
7. *Tamarix* sp.
   Harris, D.R. 1966. Recent Plant Invasions in the Arid and Semi-arid Southwest of the United States. Annals of the Association of American Geographers. 56 (408-422).
   Horton, Jerome S. Notes on the Introduction of Deciduous Tamarisk. U.S. Forest Service Research Note RM- 16. 7 p.
   Robinson, T.W. 1965. Introduction, Spread and Areal Extent of Saltcedar *(Tamarix)* in the Western States. Geological Survey Professional Paper 49 1-A. U.S. Government Printing Office. Washington D.C. 12 p.
   Thomber, J.J. 1916. Tamarisks for Southwestern Planting. Timely Hints for Farmers #121. University of Arizona Experiment Station. Tucson. 8p.
8. *Salsola tragus*
   Bessey, Charles E. 1893. The Russian Thistle in Nebraska. Bulletin of the Agricultural Experiment Station of Nebraska. Vol 6 #31. 67-73.
   Dewey, Lyster H. 1964. Migration of Weeds. Yearbook of the U.S. Department of Agriculture. Washington D.C. 263-286.
   Shinn, Charles H. 1895. The Russian Thistle in California. California Agricultural Experiment Station Bulletin # 107. 16p.
9. Larson, Andrew Karl. 1961. Agricultural and Horticultural Improvement. In: I Was Called to Dixie. (Larson, Andrew Karl), Deseret News Press. Salt Lake City . p. 352.
10. *Alhagi camelorum*
    Bottel, A.E. 1933. Introduction and Control of Camelthorn. In: Monthly Bulletin #22. California Department of Agriculture, Sacramento. 261-263.
    Colley, Charles C. 1975. Robert Humphrey Forbes of Arizona: the Frontiers of Arid Lands Agriculture. Ph.D. Dissertation, Arizona State University, Tempe. 329 p.

Colley, Charles C. 1983. The Desert Shall Blossom: North African Influence on the American Southwest. The Western Historical Quarterly (July), 277-290.

Groh, Herbert. 1940. Turkestan Alfalfa as a Medium of Weed Introduction. Scientific Agriculture 21 (36-43).

11. *Pennisetum ciliare*

Munda, Bruce. Tucson Plant Materials Center Program for Southwest Deserts. Arizona Riparian Council Newsletter 8(2) 6-8.

12. McWhorter op. cit. 1971 under *Sorghum halapense.*