Infructescence and Fruit Characteristics of *Washingtonia*

(Arecaceae: Coryphoideae)

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Washingtonia, named in honor of George Washington, first president of the United States, includes two species and one hybrid of desert fan palms from southern California, southwestern Arizona, and northwestern Mexico (Bailey 1936, Hodel 2014). *Washingtonia filifera* (California fan palm) occurs in the Colorado Desert of southeastern California, southwestern Arizona, and northern Baja California, Mexico while *W. robusta* (Mexican fan palm) is found in southern Baja California and western Sonora, Mexico. They are among the most commonly cultivated palms in the world and are especially prominent and conspicuous in southern California, where they are considered the iconic trees of the region's landscapes. In the Coachella Valley and other desert regions the large, imposing *W. filifera*, is the more common species in the landscape but in more humid and cooler coastal areas the tall, slender "sky duster" *W. robusta* predominates. In the past 30 years or so a hybrid of the two, *W.* × *filibusta*, has inadvertently become a common landscape subject and has added to the mix.

Fig. 1. West Coast Arborists, Inc. collected an infructescence from this Washingtonia robusta in Signal Hill, CA. (D. R. Hodel).

Fig. 2. West Coast Arborists, Inc. collected an infructescence of this Washingtonia filifera in Indio, CA.

Fig. 3. The infructescence of Washingtonia robusta was lowered carefully to the ground for processing. (D. R. Hodel).

Once attaining maturity, *Washingtonia* palms are prodigious producers of inflorescences (flower stalks) and later, as fruits develop, infructescences (fruit stalks). When heavily laden with infructescences, the falling fruits pose a nuisance and hazard in the landscape and infructescences along with leaves are typically removed during periodic, mostly annual pruning. Arborists and others in the tree and landscape management industries have often asked what quantities of infructescences and fruits these palms produce. This information is important because infructescences are large, bulky, and heavy and can comprise a major component of material entering the green waste stream. Other issues where fruit production is important include invasive species and potential alternative food sources. In coastal southern California seeds of *Washingtonia*, especially *W. robusta* in irrigated and even non-irrigated landscapes, germinate readily and the plants can become invasive. Indeed, *W. robusta* is officially listed as an invasive species for California (Cal-IPC 2015) and has also become invasive in parts of Hawaii (Hodel 2012). Several workers, including Richard Felger and Carolyn Niethammer in Arizona and senior author Donald Hodel, are jointly investigating the potential of fruits of *W. filifera* as a possible alternative urban food source. Cornett (1987a) discussed the nutritional value of *W. filifera* fruits and he (Cornett 1987b) and others (Chase 1919, Parry 1881) have documented the use of the fruits for food by Cahuilla Indians in the southern California deserts. Thus, there is a need to quantify infructescence and fruit production in these palms.

Fig. 4. The infructescence of Washingtonia filifera was lowered carefully to the ground for processing. (D. R. Hodel).

Materials and Methods

We collected infructescences with mature, ripe, black fruits of both species from cultivated landscape plants in California in late 2014. Those of *Washingtonia robusta* were collected in October from palms growing in Discovery Well Park in Signal Hill near Long Beach (**Fig. 1**) while those of *W. filifera* were collected in November from a city street tree in Indio near Palm Springs (**Fig. 2**). In both cases the palms were fully mature (had been flowering and fruiting for many years), about 50 feet tall, and in irrigated landscapes. They appeared to be typical and healthy specimens for their species.

We counted the number of current year infructescences to determine approximate annual production per palm. With the aid of a bucket lift we removed one, typical infructescence in its entirety and carefully lowered it to the ground (**Figs. 3-5**) where

Fig. 5. Once on the ground the large, heavy infructescence of Washingtonia robusta could be measured and fruit collected for weighing and measuring. (D. R. Hodel)

we measured and counted its length and various organs (peduncle, rachis, branches, panicles) and collected, weighed, and measured the volume of its fruits. We also counted and weighed the number of fruits in the largest and smallest panicle of each infructescence. We measured and weighed individual fruits, seeds, and mesocarps. We checked or corroborated our computations by comparing weight and volumes of a known quantity of fruits.

Results and Discussion

Table 1 summarizes the infructescence and fruit characteristics of *Washingtonia filifera* and *W. robusta*. Both species produced about the same number of current-year infructescences per palm, 12 for *W. filifera* and 13 for *W. robusta*. Because both palms had not been pruned for several years, each had additional, but old, dead, persistent

Fig. 6. The infructescence of Washingtonia filifera typically had three main branches. (D. R. Hodel).

Fig. 7. The infructescence of Washingtonia robusta typically had seven main branches.

Fig. 8. Fruits of Washingtonia: left three, W. filifera; right three, W. robusta (scale in mm). (D. R. Hodel).

infructescences from which the fruit had fallen the previous year.

Infructescences of both species are similar in structure; each has a peduncle and rachis, the latter with branches that hold the flower- and fruit-bearing panicles. The two species differ in overall size and quantity of branches and panicles. Infructescences of *Washingtonia filifera* were longer (5.8 vs. 4 m) but had fewer branches (3 or 4 vs. 7) and panicles (27 vs. 56) than those of *W. robusta* (**Figs. 6-7**).

Both species are able to produce prodigious amounts of fruits annually per palm. *Washingtonia filifera* produced 152.4 kg in 225.6 L and ca. 538,000 fruits while *W. robusta* produced 97.5 kg in 143.0 L and ca. 570,000 fruits (quantities of fruits are an average of weight and volume methods). While the quantity of infructescences and fruits per infructescence were similar for both species, the substantially greater weight of fruits per palm for *W. filifera* is primarily due to its larger, heavier fruits (0.28 vs. 0.18 g per fruit); fruits and seeds of *W. filifera* are 10 × 8 and 7.0 × 5.5 mm respectively while those of *W. robusta* are 8 × 6 and 5.0 × 4.5 mm respectively (**Figs. 8-9**). This weight difference is also reflected in the panicles; fruits of one large panicle of *W. filifera* weighed nearly four times as much yet had only about twice the quantity as in *W. robusta* (**Figs. 10-11**).

While both species have mature, ripe, black fruits with a distinct glaucous "bloom" (**Fig. 12**) that are somewhat sweet and have a date-like flavor, those of *Washingtonia filifera* were considerably sweeter and tastier than those of *W. robusta*. We initially thought that the differences in sweetness and flavor might be due to where they were growing. Signal Hill, the source of *W. robusta*, is a few miles from the coast and has a relatively cool, humid, maritime climate, which could retard sugar production and subsequent sweetness. In contrast, Indio, the source of *W. filifera*, is an exceeding hot, dry, desert climate, which could enhance sugar production. However, although we did not collect fruits of *W. robusta* in the desert, we did taste some from Palm Desert in the Coachella Valley and they were similar in flavor and sweetness to those from Signal Hill near the coast.

Fig. 9. Seeds of Washingtonia: left three, W. filifera; right three, W. robusta (scale in mm). (D. R. Hodel).

Fig. 10. A large panicle of Washingtonia filifera contained fruits that typically weighed four times and were twice the quantity as that of W. robusta (Fig. 11). (D. R. Hodel).

Fig. 11. A large panicle of Washingtonia robusta contained fruits that typically weighed one-fourth and were one-half the quantity as that of W. filifera (Fig. 10). (D. R. Hodel).

Because both species are able to produce prodigious amounts of fruits annually, they are attractive as an underexploited, alternative urban food, especially for *F. filifera* because of its heavier production and sweeter, tastier fruits. However, the prodigious fruit production also increases their potential for invasiveness; indeed, *W. robusta* is invasive in many places in California, including desert regions where it might eventually genetically contaminate *W. filifera*, and other areas around the world. Genetic contamination might already be underway in desert regions, especially in cultivated landscape palms, because most volunteer *Washingtonia* in the Coachella Valley appear to be *W.* × *filibusta*. In contrast, *W. filifera* is mostly not invasive in cooler, coastal maritime areas, likely because of its susceptibility to the fungal disease diamond scale, which can limit its growth.

Our findings for infructescences and weight and quantity of fruits per palm for *Washingtonia filifera* are similar but somewhat less than what Cornett (1985) found. He determined that in especially good (wet) years one plant of *W. filifera* could produce about 15 infructescences and 18 kg of fruit per infructescence, which comes out to 270 kg of fruit per palm. He estimated about 600,000 fruits per palm annually.

Fig. 12. Washingtonia typically have mature, ripe, black fruits with a distinct glaucous "bloom," as here in W. filifera. (D. R. Hodel).

Table 1. Infructescence and Fruit Characteristics of *Washingtonia filifera* and *W. robusta*, California, 2014.

Character	***W. filifera***	***W. robusta***
Quantity of infructescences per palm	12	13
Length of infructescence	5.8 m	4 m
Length of peduncle	1.5 m	1.2 m
Quantity of branches per infructescence	3	7
Quantity of panicles per branch	9	8
Quantity of fruits in 50 ml	118	203
Weight of 50 fruits (mesocarp, seed)	14.0 g	8.8 g
Weight of 50 seeds	6.4 g	3.7 g
Weight of 50 mesocarps	6.8 g	4.8 g
Mean weight of 1 fruit	0.28 g	0.18 g
Weight/volume of fruits of 1 infructescence	12.7 kg/18.8 L	7.5 kg/11.0 L
Weight/volume of fruits of 1 palm	152.4 kg/225.6 L	97.5 kg/143.0 L
Quantity of fruits of 1 infructescence based on weight	45,357	43,103
Quantity of fruits of 1 palm based on weight	544,286	560,345
Quantity of fruits in 1 infructescence based on volume	44,344	44,660
Quantity of fruits of 1 palm based on volume	532,128	580,580
Weight of fruits of 1 large panicle	1,014 g	297 g
Quantity of fruits in 1 large panicle	3,186	1,698
Quantity of fruits in 1 small panicle	600	60
Fruit dimension	10 × 8 mm	8 × 6 mm
Seed dimension	7.0 × 5.5 mm	5.0 × 4.5 mm

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