GUIDELINES FOR THE

SELECTION, SALVAGE,

TRANSPORT AND INSTALLATION

OF FIELD SALVAGED

Phoenix dactylifera

PALMS©

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Preface

The following general specification guidelines are intended to limit the variables which promote the failure of field salvaged *Phoenix dactylifera* palms installed into ornamental landscape sites. Sections on the selection, salvage, transport, and installation of *Phoenix dactylifera* palms are provided. Photographs and documentation are provided where applicable.

Scope of Document

The sole purpose of this document is to provide a general set of horticulturally based guidelines for the installation of field salvaged *Phoenix dactylifera* palms into ornamental landscape sites. Elements of project contract, design, environmental impact and engineering are expressly defined as outside the scope of this document. Do not proceed with any specification that poses a site specific conflict of any nature.

Phoenix dactylifera-General Information

The *Phoenix* genus is reported to include seventeen (17) species, of which *dactylifera* is one (1). *Phoenix* species palms are commonly referred to as date palms. The date palm is dioecious (male/female trees).

Phoenix dactylifera, The Edible Date Palm, is erect, growing to a height in excess of one hundred (100) feet. *Phoenix dactylifera* is an agriculturally important palm. The single trunk is covered from the ground up with vertical, overlapping, persistent, woody leaf bases. After the first eight (8) to fourteen (14) years, numerous suckers (offshoots) will develop at the base of, or along the parent stem. The growing point (meristematic region) of *Phoenix dactylifera* is near the top of the stem. Radial development of the stem vasculature in young plants is necessary before notable gains in stem height occur. Addition of stem occurs as old fronds are replaced by new. Loss of the growing point near the stem apex results in loss of the stem.

The feather-like (pinnate) fronds, up to twenty (20) feet long, are composed of a spiny petiole, a stout midrib, and slender, gray-green to bluish-green leaflets (pinnae) eight (8) to sixteen (16) inches long, folded in half lengthwise (induplicate). Each frond emerges from the apex of the stem to take its place in a strict spiral arrangement. Annual frond production ranges from nine (9) to twenty one (21).

The flowers of the female palm are individually minute, round, fragrant, and whitish in color. They are borne on a branched, pendulous, stalk (inflorescence). The female inflorescence is divided into twenty five (25) to one hundred fifty (150) strands, each twelve (12) to thirty (30) inches long. The flowers of the male palm are individually minute, with three (3) to four (4) distinct lobes, fragrant of musk, waxy, and cream colored. The male inflorescence is divided into strands six (6) to nine (9) inches long. Both male and female palms are pleonanthic (flowering repetitively) and flower intrafoliarly (flowers occurring amongst the fronds). Annual inflorescence production may exceed eight (8), with each inflorescence bearing up to ten thousand (10,000) individual flowers. Pollination of the female flower by male pollen is necessary for the development of edible fruit, which occurs on the female tree only. As the fruits develop, the stalk holding the cluster (infructescence) becomes pendulous with the weight of the fruit, growing to a length of up to six (6) feet. The fruit (date) is oblong, one (1) to three (3) inches long, dark brown, reddish, or yellowish brown when ripe. The hard stoned is grooved on one side and is covered by a sweet, edible flesh.

The root system is comprised of four (4) branch orders (R_1-R_4). The first order (R_1) is the largest, with its' main functions being anchorage and to supply a framework for the remaining three (3) orders to branch from. The first (R_1) and second (R_2) orders are aerenchymous (containing air channels). Second order (R_2) roots which rise vertically (negatively geotropic) to the surface of

the soil are known as pnuemathodes, their function is to aerate the rootzone in the event it is flooded. Pnuemathode roots often cover the lower portion of the stem on taller specimens, their development commencing as the palm ceases to develop offshoots at/near the stem base. These roots are commonly referred to as "air roots" by the trade. The third (R_3) and fourth (R_4) order roots are the smallest respectively, and are responsible for water and mineral nutrient uptake.

Phoenix palms cross hybridize freely. Due to a high degree of genetic variance within the species, seedlings of *Phoenix dactylifera* often vary greatly from the mother palm that bore their seed. In light of this potential for variance, farmers of *Phoenix dactylifera* propagate their groves by cutting offshoots from mature palms. This method of clonal propagation ensures the genetic stability of their crop. More than fifteen hundred (1,500) varieties (cultivars) of the agriculturally important Phoenix *dactylifera* have been described.

Mature specimens of *Phoenix dactylifera* palms are procured for ornamental landscape sites from commercial date groves, with the Coachella Valley of Southern California being the dominant source. The supply of male palms is generally very limited, due to the ratio at which growers propagated male palms in comparison to female palms (one (1) male to fifty (50) females). Only three (3) varieties of female *Phoenix dactylifera* are available in quantity. They are:

'Deglet Noor'-introduced into the Coachella Valley commercial date groves in 1900 by offshoots imported from Algeria and Tunisia, where it is the main export variety. The 'Deglet Noor' variety continues to dominate the commercial date groves of the Coachella Valley. The fronds have a pendulous habit and are olive green in color. The crown has an open, airy appearance. 'Deglet Noor' generally speaking, has the largest stem diameter of the three (3) most commonly available female varieties. The production of offshoots by 'Deglet Noor' is limited to the area near the stem base. The petiole bases from expired fronds are generally shed from 'Deglet Noor'. The rooting habit of 'Deglet Noor' may be considered shallow in comparison to other varieties, with numerous air roots developing near the stem base, especially at uncultivated sites. The long term performance of 'Deglet Noor' in median strips or cramped sites tends to be poor, especially if palms were procured from a flood irrigated grove in comparison to a drip irrigated grove. 'Deglet Noor' transplanted into a cramped site tends to develop a dense air root mat. This condition ultimately affects water and nutrient delivery, lending to an overall poor palm condition. The ornamental use of 'Deglet Noor' is best suited to an open situation in a climate of low rainfall and low humidity. A generic request for *Phoenix dactylifera* from a palm supplier is most likely to result in the delivery of the 'Deglet Noor' variety.

'Medjhool'-eleven (11) offshoots of this variety were imported into the United States from Morocco in 1927. After surviving a successful quarantine period in Searchlight Nevada, these offshoots were used to propagate this variety in the commercial date groves of the Coachella Valley. 'Medjhool' is highly valued due to the large, sweet fruit it produces. The distinctly bluish green fronds are held erect, giving the crown a dense appearance when compared to 'Deglet Noor'. 'Medjhool', generally speaking, has the median stem diameter of the three (3) most commonly available female varieties. The production of offshoots by 'Medjhool' occurs both near the stem base and along the first six (6) feet of the main stem. The petiole bases from expired fronds are persistent if undisturbed. The rooting habit of 'Medjhool' is less shallow than that of 'Deglet Noor', especially in palms procured from a flood irrigated grove. Of the three (3) most commonly available female varieties, 'Medjhool' palms procured from a drip irrigated grove are most likely to perform well in a cramped ornamental site. High humidity levels affect the development of new fronds in 'Medjhool', delaying their elongation, especially if the site is poorly drained. When requesting the variety 'Medjhool' for an ornamental landscape site, one can expect to receive high quality palms, at a premium price. This is due to the high market price for the superb fruit cropped from 'Medjhool'.

'Zahidi'-the oldest described variety, the dates from 'Zahidi' are produced in great quantities in the Middle East. Introduced into the date groves of the Coachella Valley around 1900, 'Zahidi' has

enjoyed limited success due to the demand for its fruit in comparison to 'Medjhool'. The fronds of 'Zahidi' are held stoutly and are the greenest of the three (3) most commonly available female varieties. The dense, green crown reminds one of *Phoenix canariensis* (The Canary Island Date Palm), making 'Zahidi' a popular choice of landscape architects. The trunk, however, lacks the stout appearance of the Canary Island Date Palm and tends to have the smallest diameter of the three (3) most commonly available female varieties. The production of offshoots by 'Zahidi' occurs both near the stem base and along the entire length of the main stem. It is not uncommon to see large 'Zahidi' palms producing crown offshoots. Unattended crown offshoots may develop into a hazard at an ornamental site if they are allowed to develop. As they increase in size, the likelihood that they will break away from the parent stem increases. The petiole bases from expired fronds are generally shed from 'Zahidi'. The rooting habit of 'Zahidi' is similar to that of 'Medjhool'', with palms procured from a drip grove performing better than 'Deglet Noor' in cramped ornamental sites. While touted as drought tolerant, high humidity lessens the strong appearance of a 'Zahidi' crown. The intermittent demand/pricing for the fruit of 'Zahidi' may affect the quality of specimens available to the ornamental landscape markets. When choosing 'Zahidi', one should be certain that palms are procured from a grove that has been under constant agricultural production.

***Phoenix dactylifera*-Agricultural Production**

While the origin of *Phoenix dactylifera* is unknown, history knows the palm as being agriculturally cultivated for at least five thousand (5000) years. The date continues to be a staple food from North Africa to the Persian Gulf. The cropping of dates requires skill and intensive manual labor. Production of a crop of dates necessitates eight (8) to ten (10) trips to the crown to perform tasks ranging from fertilizing the female flowers with male pollen by hand to wrapping developing date bunches in paper or cloth to protect them from insects as they ripen. Thorns are removed from the fronds below the inflorescence to prevent injury to workers working the crowns.

Due to the unpredictable genetic variance that occurs in palms grown from seeds, propagation of date groves is done by removing offshoots from mature palms. Some fifteen hundred (1,500) cultivars of *Phoenix dactylifera* were described in the work of Popenoe (1973), each with differing physical and fruiting characteristics. Since the pollen from one (1) male is sufficient to fertilize the inflorescence of fifty (50) females, the ratio of females to males in a commercial date grove is generally fifty (50) to one (1).

With the completion of a feasibility study on the commercial production of dates in the United States by the Department of Agriculture (Swingle.1904), mass importation of offshoots commenced in earnest after 1904. While offshoots were imported to Texas, Arizona, and Nevada, those planted in the Coachella Valley of Southern California enjoyed the greatest success. To this day, the Coachella Valley is, by far, the dominant date production region in the United States. An inventory of cultivars known to be growing in the United States in 1924 (Popenoe.1973) named one hundred thirty (130). Today, three (3) cultivars dominate the date groves of the Coachella Valley; 'Deglet Noor', 'Medjhool', and 'Zahidi'.

The climatic and cultural requirements for the successful production of dates are stringent. *Phoenix dactylifera* requires full sun. Specimens are set twenty seven (27) to thirty (30) feet apart in commercial date groves to avoid shading. The palm is intolerant of humidity, especially during flowering and ripening of the dates. Rain during the ripening period will destroy the crop. While *Phoenix dactylifera survives* seventeen (17) degrees F with little effect, it becomes basically dormant from an agricultural standpoint when ambient temperatures fall below fifty (50) degrees Fahrenheit (Mason.1925). For production of dates, a long growing season with temperatures in excess of ninety (90) degrees is necessary.

While palms under agricultural production will use copious amounts of water, they are intolerant of poorly drained soils. Soils with an infiltration rate of less than one (1) inch per hour should be

avoided. Able to thrive in soils with high pH and salinity levels, they perform poorly when the ground around them is not cultivated on a regular basis. Fertilization of agriculturally cropped *Phoenix dactylifera* is usually via application of manure and tilling of spent fronds. The mechanical structure of the date palm is such that high winds have little effect on it (Pfalzgraf.2000). In summary, *Phoenix dactylifera* produces the best dates in the harshest arid climates, with its only requirements being a water source other than rain, a free draining soil, cultivation, and knowledge of its husbandry.

The climactic and cultural demands *Phoenix dactylifera* are far less stringent when it is used in an ornamental setting, where the production of fruit is not an issue. While it will tolerate rain, humidity, and some level of drought when the production of dates is not important, it will not tolerate poorly drained soils.

Market influence on quality/price of *Phoenix dactylifera* specimens

When selecting *Phoenix dactylifera* as a tree for an ornamental landscape site, remember that the quality of the specimens available will be influenced by the economic factors that influence the commercial date industry. Low demand, coupled with low fruit prices, make it difficult for a date grower to supply the optimum care for their palms. For example, if the production costs exceed the monetary return on the fruit, a grower may not be able to crop a grove until market prices recover. Palms salvaged from a grove with a history of abandonment are more likely to experience problems when transplanted compared to those with a history of constant production. When requesting a constant production history, one can expect to pay a premium price.

The demand for *Phoenix dactylifera* as an ornamental landscape tree in temperate landscapes across the United States may be exceeding level of its production as an agricultural commodity in the commercial groves of the Coachella Valley. This trend will only continue to escalate the prices one can expect to pay for palms.

Transplanting *Phoenix dactylifera* palms

The ability of palms to store large amounts of water and starch in their stems make them ideal candidates for transplanting. With a great deal of the root system cut off when the palm is pulled out of the ground, it's ability to absorb water and mineral nutrients is greatly reduced. Water stored in the stem is mobilized to supply fronds (leaves) the water they need until the root system re-develops. Starch stored in the stem is mobilized to meet the demands of the re-developing root system. Some nutrients are moved from older fronds to newer fronds (translocation) until the root system re-establishes itself to resume its ability to take up nutrients. In summary, the ability of the palm to store water and starch, and to move some nutrients, are the mechanisms by which transplanted palms stay alive until their root system re-establishes itself.

The research (Mason.1925) tells us that *Phoenix dactylifera* becomes basically dormant when ambient temperatures fall below fifty (50) degrees Fahrenheit. Root re-establishment occurs best in *Phoenix dactylifera* when soil temperatures are above seventy (70) degrees Fahrenheit (Pfalzgraf.1999). Installing *Phoenix dactylifera* when temperatures are below this threshold results in delays in root re-establishment and increased use of storage reserves. With increased expenditure of storage reserves comes an increased chance that the palm will not survive the transplant or that it will have problems in re-establishment. When you install palms during the period from late fall to early spring, be aware that you can expect higher failure potentials and/or problems in re-establishment. Schedule your project accordingly.

The importances of the quality of the palms, and the factors that affect this quality have been discussed in a previous section.

The salvage contractor cuts the roots of the palm, generally using a trencher. After cutting the roots, the palm is removed using a front end loader that has been affixed with a cable supported, stiff arm boom. The sides and bottom of the rootball should be shaved with a sharpened shovel. This removes the ends of damaged roots and provides a flat surface which is easier to transport and plant. The subterranean portion of the stem is called the caudex. All new roots develop from the caudex. The caudex is a main intake into the stem and crown. Cutting a shallow rootball may result in damage to the caudex. Palms with damaged a damaged caudex may experience an increased susceptibility to pathogens. If one can see a roughly circular band of tissue at the bottom of a salvaged rootball, it is a sign that the caudex has been damaged.

The old leaf bases are often removed to make the appearance of the trunk more attractive. It is felt by some that the use of a chainsaw in ornamental trunk preparation favors the spread of pathogens (in that chainsaws cannot be sterilized) and that the exterior portion of the vascular system of the stem could be damaged if the saw operator cuts too deeply. The terms shovel cut, classic cut, and step cut are often used to describe ornamental trunk preparation. Be aware that the ornamental preparation of the trunks of *Phoenix dactylifera* palms has been patented (United States Patent and Trademark Office nos. 5184656, 5029380). Be certain that your supplier is not in violation of patent laws in delivering *Phoenix dactylifera* palms with an ornamental trunk preparation.

Inflorescence (fruit/flowers) should be removed from the crown. Removal of an excessive portion of the crown (fronds) should be avoided; at least two (2) rows of fronds below the current season's inflorescence should remain. The ends of the fronds should not be cut off (bobbed). The crown should be tied up and secured in at least two (2) locations with a bio-degradable twine.

The utmost caution must be used when salvaging, handling, and loading the palm(s). The new fronds and the apex of the stem are quite delicate and can be damaged by rough handling (shock loading). Damage to the stem apex may not become apparent until after the crown is opened at the site to which it was relocated. All rigging should be of a nylon sling configuration with proper load ratings. Chains or steel cables should never be used.

The palm(s) should be loaded onto a flat bed trailer for transport to the installation site in a manner that avoids load isolation along any portion of the stem. The crown(s) of the palm(s) should not be unsupported, crushed, or left to flop about off the end of the trailer. The entire load should be covered. The rootball(s) should be never be allowed to dry out, replenishing their moisture level may be necessary if the palms are transported an extended distance.

Some states require a certificate of quarantine compliance to accompany any *Phoenix dactylifera* palms that will be transported across their state's border. This certificate is issued by the department of agriculture representing the state in which the palms were grown. You should request this certificate to accompany any delivery of palms you accept.

The installation site should be prepared prior to the delivery on the palm(s) to avoid unnecessary crane costs. The planting pit should be excavated so as to allow clearance of no less than two (2) feet on any side of the rootball. The planting pit should not be any deeper than the depth of the rootball, crown burying palms promotes delay in their re-establishment (Pfalzgraf.1999) and makes them susceptible to pathogens and nutrient deficiencies (Chase and Broschat.1991). The sides of the planting pit should be roughened, as smooth or glazed sides may result in an interface, a zone that roots cannot penetrate.

Phoenix dactylifera palms must have positive drainage. A review of the engineering work concerning the soils at your planting site is recommended before deciding upon *Phoenix dactylifera* as part of your plant palette. The percolation rate at the bottom of the planting pit should be at least one (1) inch per hour. Lacking positive drainage, it may be necessary to drill a drainage chimney at the bottom of the planting pit to reach soils below that have the desired percolation rate. Such chimneys are often twelve (12) inches wide, filled with fine gravel, and

covered with a landscape fabric at their interface with the bottom of the planting pit. It is always the best to install palms into soils with positive drainage. A drainage manifold should be placed into the planting pit. The manifold is constructed of four (4) inch drain pipe. A section of perforated pipe is wrapped in drain pipe socking and installed at the bottom of the planting pit. Four (4) inch elbows are glued onto the ends of the perforated pipe section. Non-perforated sections are glued into the open ends of the elbows and are continued up the sides of the planting pit to the surface. The manifold allows one to check for/drain excess water during the re-establishment of the palm(s). Installing aeration tubes (straight sections of pipe which dead end into the bottom of the planting pit) serve no purpose in that they do not allow one to drain excess water from the bottom of the rootball, should it become necessary. Never water down a drainage manifold. The top pipes of the drainage manifold should be cut to grade and finished with a four (4) inch cap that protects it from pollution.

The crane used to set the palm(s) should be of a sufficient rating so as not to have difficulty in handling trees with a per trunk foot weight of five hundred (500) pounds or more. All rigging should be of a nylon sling configuration with proper load ratings. Chains or steel cables should never be used. Use the utmost care in handling the palm(s), remembering that the stem apex is easily damaged. All personnel in the vicinity of cranes should be equipped with proper safety apparel. The area in which the crane is operating, especially its swing area, should be cordoned off to protect the safety of passersby. Conform to regulations concerning lane closures should it be necessary to position the crane on vehicular thoroughfares when setting the palm(s).

Again, do not place the rootball or any portion of the trunk subgrade (crown burial). It is better to have some variance in height between palms than to bury some of them too deep in order to match their heights. Palms which are crown buried are more likely to have a difficult re-establishment than those which are installed with the top of the rootball at grade.

The rootball should be wet before the palm is planted. The backfill material should be coarse sand. This material offers positive drainage and good aeration characteristics. The terms 'washed mortar sand' and 'plaster sand' are commonly used by suppliers of these materials. Obtain an agricultural laboratory report on the backfill material from your supplier. Avoid using materials which have been identified by the laboratory report as having excessive sodium or calcium levels. Do not add organic matter at the time of installation. Construct an irrigation basin around the palm, water thoroughly. Be certain the palm is stable before releasing the crane.

It is advisable to stake the palm(s) until re-establish of the root system is well underway. Never nail into the trunk; palms cannot repair wounds. One method of staking involves banding sections of wood to the trunk using a steel banding material. Braces are then nailed to the banded wood, with the ground end secured to stakes with a length of at least forty eight (48) inches driven into undisturbed site soil. Staking palms protects developing roots from being torn should wind be an issue at the site.

An automatic irrigation system should be installed at the time of installation of the palm(s). Since palms have water requirements that may vary dramatically from other plant types both seasonally and in quantity, palms should be valved separately. The configuration should allow the rootzone of the palm to be irrigated uniformly, especially at the interface of the rootball and the backfill material. Overhead spray configurations should be avoided as they promote erosion of stem tissue that cannot be repaired. While flood bubblers are commonly used, their output may exceed the soil percolation rate, making multiple cycles necessary during the warmer months of the year. If flood bubblers are your choice, chose a product with a pre-set output. Adjustable type bubblers make the maintenance of irrigation uniformity across the population an ongoing task. A drip type configuration may be the best choice. When laying out the irrigation system at your palm(s), keep uniformity in mind at all times. Maintain uniformity in quantity of product, its output, and its placement.

When palms are transplanted, their limited root system makes their ability to absorb water limited as well. As their root system re-establishes, the uptake capacity of the palm increases. It is difficult, if not impossible to guess how much water the palm requires at any given time. Irrigation schedules should be based on tensiometer readings. Installation of a twelve (12) inch and a thirty six (36) inch instrument into the root zone of a palm considered representative of site conditions is suggested. It may be necessary to install more than one (1) set of instruments if conditions vary at palms across the population. The instruments should be prepared as per manufacturer's recommendations and installed just to the outside of the interface of the rootball and backfill material.

Schedule irrigations so as to maintain field capacity for coarse sand (assuming coarse sand is the backfill material) at the twelve (12) inch instrument, monitoring the thirty six (36) inch instrument to identify excess moisture accumulating in the lower rootzone. Any excess water will collected in the drainage manifold. If this condition if found, pump the excess from the manifold, measure the amount of excess, compare it to the output of your irrigation system at the palm affected, and adjust your irrigation timing to eliminate the excess amount. It may be necessary to install an inline valve into the configuration at individual palms if their performance varies widely from others on the zone.

Your local irrigation materials distributor should be able to supply you with soil tensiometers, technical advice on their use, and any tools necessary in their maintenance and service. Remember, as your palm(s) re-establishes its root system, its ability to take up water will increase. These increases will be reflected by the tensiometer readings and it will be necessary to adjust your irrigation scheduling accordingly. Long after the palms have re-established, you will find the tensiometers useful in making irrigation scheduling adjustments as the seasonal water requirements of the palms change.

Do not allow pollution of the sand backfill at your palm(s). This commonly occurs as secondary plants are installed in the vicinity of newly installed palms. Even a thin layer of a heavier soil type over the sand backfill will dramatically alter water infiltration and rootzone aeration characteristics.

The crowns of transplanted palms are tied to limit moisture loss. An open crown will transpire more water than one that is tied. Until roots re-establish to resume their role in water uptake, the palm survives on water stored in its stem. Opening crowns before root re-establishment begins promotes unnecessary use of stem water reserves. Inspect for sign of root re-establishment on a weekly basis after your palms are installed. This involves digging along the rootball/backfill interface with a hand trowel. Be aware that roots often re-establish eighteen (18) inches or more below grade, so excavate accordingly. When you find fleshy white roots making their way into the backfill, open the crown. Sterilize tools used in the rootzone by immersing them in a fifty (50) fifty (50) solution of bleach and water for no less than five (5) minutes between specimens.

When the crown is opened, it may be necessary to remove spent fronds from the lower portion of the crown. *Phoenix dactylifera* palms are susceptible to vascular wilts. These wilts can be fatal, and can be spread by chainsaws or unsterilized pruning tools. Remove spent fronds with a handsaw or date hook sterilized by immersion in a fifty (50) fifty (50) solution of bleach and water for no less than five (5) minutes between specimens. Do not remove green fronds. Do not use a chainsaw to prune palms.

Fertilize your palms at the time the crown is opened. A granular product formulated for the nutritional needs of palms should be used. Apex™ 13-5-8 Palm Special is an example of one (1) available product. Apply the product as per manufacturer's recommended rates and frequencies. Be aware that some fertilizers contain elements that will stain hardscape surfaces if the product is left to drift about. Apply the product in such a way that it will be irrigated in. It may be necessary to place the product under drip components, if that is the configuration at your site. After applying the fertilizer, apply a two (2) inch layer of well decomposed organic mulch to the top of the rootzone.

In summary, a *Phoenix dactylifera* palm which has been under agricultural production, is salvaged/transported/installed with promptness and care during proper season, and given attentive management during it's re-establishment should make a successful transition into the ornamental landscape. Most problems and failures with transplanted palms are due to delays in root re-establishment. As storage reserves of starch and water are depleted from the stem, the palm has a decreasing chance of survival. Root re-establishment can be influenced by factors such as planting grade, soil temperature, soil moisture levels, drainage, etc. The condition of the specimen prior to its salvage is very important to whether it will survive the transplant. While palms will generally transplant easily, the success we enjoy will be influenced by how quickly the palm re-establishes roots. With delays in root re-establishment comes expenditure of water and starch stored in the stem. As more of these reserves are expended, the chance of losing the palm increases.

GENERAL SPECIFICATIONS

FOR THE

SELECTION, SALVAGE,

TRANSPORT AND INSTALLATION

OF FIELD SALVAGED

Phoenix dactylifera

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SECTION I-STOCK

I-01: Owner choice of stock-Owner shall reserve the right to choose individual specimens from supplier available stock at salvage site, prior to salvage.

I-02: Origin of stock-All stock shall be provided from clonally (offshoot) propagated *Phoenix dactylifera* palms grown under constant agricultural production. Palms of seedling origin will not be considered.

I-03: Variety of stock-Owner shall specify variety of stock at time of initial order. If no specification is made, the variety 'Deglet Noor' will be considered the default variety. Shipments of mixed varieties will not be accepted.

I-04: Offshoots-Stock shall be free of offshoots. Palms that have had offshoots removed less than one (1) year prior salvage should not be considered for stock. Stems with fresh offshoot scars will not be accepted. Stems that have been damaged by offshoot removal will not be accepted.

I-05: Gender of stock-Unless otherwise specified, it is assumed that all stock will be of the female gender of the specified variety.

I-06: Fresh salvage-All stock must be salvaged no more than twenty four (24) hours prior to arriving to installation site. In the case that fresh salvage stock is unavailable, owner must approve in writing, palm specimens which have been heeled in at storage yards prior to shipment. In requesting this approval from owner, supplier shall supply the original salvage date.

I-07: Brown trunk height measurement-Owner requested brown trunk height of palm shall not vary in excess of five (5) percent and shall be the actual measurement from the top of root ball to the top of the ornamental nut/ball as seen in Figure 1 (also see salvage section III-05). Measurements from top of root ball to stem apex shall not be accepted.

Figure 1-Brown trunk height (BTH) measurement area

I-08: Insect/disease infestation-Palms shall be free of known insect and/or disease infestation/infection. A certificate of quarantine compliance issued by the applicable state agriculture department from the point of origin shall accompany the palm shipment. Shipments shall be in compliance with applicable local and state department of agriculture regulations at the point of delivery. Palms arriving without a certificate of quarantine compliance will not be accepted.

I-09: Stem curves/structural abnormalities-Palms shall have straight stems and be free of taper variances, splits, and curves (Figures 2-4).

Figure 2-Negative stem taper variance

Figure 3-Stem split

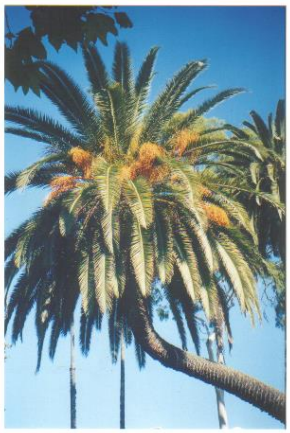

Figure 4-Radical stem curvature

SECTION II-SALVAGE

II-01: Salvage status- All palms shall be fresh salvaged (see sections 1-02, I-04).

II-02: Hoisting equipment-Hoisting equipment shall be sufficiently rated as to remove, handle, and load palms without difficulty (Figure 5) to avoid dynamic (shock) loading and resultant crown/stem apex damage.

Figure 5-Equipment hoisting capacity exceeded while pulling palm

II-03: Rigging-All rigging shall be constructed of nylon. Consult rigging manufacturer for load ratings/rigging configuration prior to use of nylon slings. Use of softeners, shackles, clevaces, etc. to prevent damage to stem, ball, or rigging as necessary is recommended. Use of chains or braided steel chokers is not acceptable. Palm stems which show rigging constriction damage will not be accepted.

II-04: Rootball-Rootballs shall be trenched and prepared as such that the delivered rootball size is no less than thirty six (36) inches wide and sixty (60) inches deep. Rootballs shall be shaved with a sharp instrument to remove damaged roots and to create a dimensionally uniform surface for stability at the installation site. Palms with unshaven rootballs (Figure 6) or improper dimensions will be rejected. Do not use tools or equipment to cut or prepare rootballs that have been previously used in diseased rootzones without proper sterilization by immersion for five (5) minutes in fifty-fifty (50-50) bleach water solution.

Figure 6-Unshaven rootball

II-05: Crown preparation-Crown shall be shipped with a minimum of two (2) rows of fronds below the current inflorescence (fruit/flower) position. Crown shall be elevated and tied prior to rolling for ornamental preparation of down side of stem to avoid twisting of fronds. Inflorescence (fruit/flowers) shall be removed from the crown. Crown shall be tied with bio degradable twine at a minimum of three (3) positions. Bobbing (reducing length) of fronds is unacceptable. Removal of random fronds to facilitate crown tying is unacceptable. Crown preparation tools shall be sterilized between specimens via immersion for five (5) minutes in fifty-fifty (50-50) bleach water solution. Use of chainsaws in the preparation of the crown is not permitted.

II-06: Stem/Ornamental Nut Preparation-Superficial air roots at lower stem portion shall be shaved with a sharpened tool so as to give smooth and uniform appearance. Remnant petiole bases shall be trimmed so as to give a uniform appearance to the palm stem. The appearance of trimmed petiole bases should not vary from palm to palm. Trimming of superficial air roots and/or remnant petiole bases should be performed in a manner so as not to cut into the live vascular tissue of the stem. Remnant petiole bases shall not be pruned from the upper portion of the stem below the crown, forming an ornamental nut. The ornamental nut shall be uniform in appearance and be of a length no less than forty-eight (48) inches and no more than sixty (60) inches. The appearance of ornamental nuts shall not vary from palm to palm. Any tool used in the ornamental preparation of the stem shall be sterilized between specimens via immersion for five (5) minutes in fifty-fifty (50-50) bleach water solution. Supplier assumes, and agrees to hold owner free of responsibility for any/all matters of litigation involving patent infringement resulting from ornamental preparation of the stem.

SECTION III-LOADING/TRANSPORT

III-01: Loading/transport rigging-All rigging shall be constructed of nylon. Consult rigging manufacturer for load ratings/rigging configuration prior to use of nylon slings. Use of softeners, shackles, clevaces, etc. to prevent damage to stem, ball, or rigging as necessary is recommended. Use of chains or braided steel chokers is unacceptable. Palms shall be picked horizontally (Figure 7), rigged at two points, and handled in such a manner as to avoid dynamic (shock) loads. Rigging used to secure palms during transport should not damage palm stems. Palm stems which show rigging constriction will not be accepted.

Figure 7-Palm rigged to be picked horizontally with nylon slings

III-02: Support/protection of crown-Palms shall be loaded to provide uniform support to crown. Use of support cribbing to provide horizontal stability to crown is recommended. Crushed crowns, piggy backed loads (Figure 8), and unsupported crowns (Figure 9) will not be accepted.

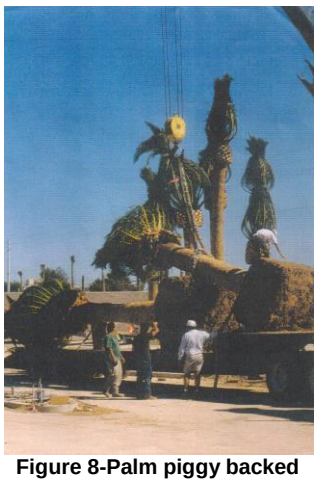

Figure 8-Palm piggy backed to save shipping costs

Figure 9-Crown hanging off end of trailer

III-03 Protection/care of palms during transport-The entire palm shall be tarped (Figure 10). Uncovered or partially tarped loads will be not be accepted. Rootball moisture will be maintained during palm transport. Stops to replenish rootball moisture en route are recommended. Palms arriving to installation site with dry rootballs will not be accepted.

Figure 10-Tarped trailer load of palms

III-04: Certificate of quarantine compliance-Palms shall arrive to installation site with certificate of quarantine compliance issued by state department of agriculture from point of origin and be in compliance with regulations of the state department of agriculture at the point of delivery (see section I-08). Palms which arrive without a certificate of quarantine compliance will not be accepted.

SECTION V-INSTALLATION

IV-01: Site conditions-*Phoenix dactylifera* palms should not be considered suitable to a site that lacks positive drainage or to a site that can experience temperatures of seventeen (17) degrees Fahrenheit or less. *Phoenix dactylifera* palms should not be installed under utility lines.

IV-02: Season of installation-Palms shall be installed when average ambient temperatures are above fifty (50) degrees Fahrenheit and when average site soil temperatures are in excess of seventy (70) degrees Fahrenheit. An owner request to install palms when Fahrenheit temperatures are below defined will be accompanied by owner acceptance of loss related costs.

IV-03: Location of Utilities-Owner shall verify planting pit site(s) to be free of utility piping, cabling, etc. prior to commencement of excavation/auguring of drainage chimneys by installation contractor.

IV-04: Excavation-Excavation equipment shall be situated as to avoid damage to hardscape elements. Proper safety procedure shall be practiced including re-routing of pedestrians and compliance with traffic lane closure requirements as applicable. Excavated planting pit shall be a minimum of twenty four (24) inches larger than the rootball dimension at any side. Native soil shall not be disturbed at a depth of more than six (6) inches deeper than the depth of the rootball. Planting pit sides shall be roughened to promote future root penetration and the avoidance of an interface. Completed planting pits shall be open no longer than twenty four (24) hours during which time they shall be affixed with four (4) posts, safety flagging, and signage which clearly exhibits the presence of a fall hazard at the site.

IV-05: Percolation (positive drainage)-Installation contractor shall verify drainage at the planting pit by application of twenty four (24) inches of water to the planting pit, which shall be free of standing water twenty four (24) hours after application. Installation contractor shall request the presence of owner representative at time of water application and at the time of inspection for positive percolation twenty four (24) hours later. Sites which fail percolation testing must be provided with an augured hole (drainage chimney) of twelve (12) inches in diameter, affixed with

a section of four (4) inch perforated drain pipe wrapped in drain pipe socking centered in drainage chimney hole. The space between the drain pipe and the face of the drainage chimney shall be filled with gravel of diameter plus minus one (1) inch. The depth of the drainage chimney will be that at which point positive percolation has been achieved. Landscape fabric shall cover the drainage chimney at the planting pit bottom interface. Variance from the drainage chimney requirements at planting pits which fail percolation testing requires written approval of owner. In assuming site has positive drainage prior to contractor activity, owner shall assume additional costs related to the auguring and materials necessary to complete drainage chimney. Safety procedures described at section IV-04 shall be practiced at any open, unattended planting pit.

IV-06: Drainage manifold-A drainage manifold (Figure 11) shall be installed at each planting pit. Site tube configurations will not be accepted. The manifold shall be constructed with two (2) upright sections of four (4) inch drain pipe extending vertically above finish grade, with the connecting section at planting pit bottom constructed of four (4) inch perforated drain pipe wrapped with a drain pipe socking. At planting pits with drainage chimneys the drainage manifold shall be connected to the four (4) inch perforated drain pipe at the center of the drainage chimney. The portion of the drainage manifold assembly at the bottom of the planting pit shall be covered with backfill material as is necessary to provide proper grade to the planting.

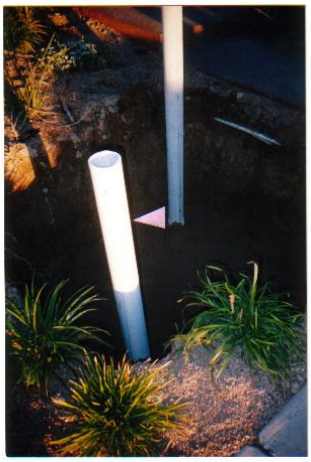

Figure 11-Drainage manifold installed into planting pit

IV-07: Backfill material-The backfill material shall be one hundred (100) percent washed mortar (concrete) sand. The backfill material shall be free of organic matter. The installation contractor shall supply the owner with a representative soil analysis to provide by the supplier of the backfill material prior to installation of any palm.

IV-08: Notification of installation-Installation contractor shall notify owner no later than seventy two (72) hours prior to arrival of palms. Installation contractor shall supply copy of applicable lane closure permits and resolve any anticipated operations disruption issues with owner representative at this time.

IV-09: Safety at installation site-Installation contractor shall see to the completion of lane closures, crane swing area protection, pedestrian re-routing, etc. at installation site prior to commencing installation activities.

IV-10: Inspection of arriving palms-Installation contractor shall request the presence of owner representative for inspection of palms at time of arrival of palms. Installation contractor shall request acceptance of palm specimen by owner representative and supply certificate of quarantine compliance to owner representative prior to unloading of any palm. Palms unloaded in the absence of owner representative will be not be accepted.

IV-11: Hoisting equipment-Hoisting equipment shall be sufficiently rated as to unload and set palm(s) without difficulty to avoid dynamic (shock) loading and resultant damage to palm(s).

IV-12: Rigging-All rigging shall be constructed of nylon. Consult rigging manufacturer for load ratings/rigging configuration prior to use of nylon slings. Use of softeners, shackles, clevaces, etc. to prevent damage to stem, ball, or rigging as necessary is recommended. Use of chains or braided steel chokers is unacceptable.

IV-13: Installation of palm into planting pit-Rootball surfaces shall be thoroughly watered immediately prior to the installation of palm into planting pit. The top of salvaged rootball will be at grade. Crown burial of any portion of the stem, including the portion covered with air roots will not be permitted. Palms shall be installed with backfill (see IV-07) being jetted with water to remove air pockets. Backfill material shall be sufficiently compacted to provide stability to palm. Hoisting equipment/rigging shall not be removed from palm until such time as it is deemed stable. A water basin shall be constructed with berms formed no less than twenty-four (24) inches from the stem base. The palm(s) shall be watered thoroughly at the time of installation.

IV-14: Staking-Stake (Figure 12) accordingly to provide specimen stability and to provide safety to potential targets in area. Staking system should be attached in a manner that does not damage stem. Staking system anchors should be a minimum of forty-eight (48) inches in length and driven into undisturbed site soil. Stake anchors should be clearly marked to avoid a trip hazard. Staking system shall remain in place until rooting progresses to point of specimen stability without aid.

Figure 12-Example of staking system

IV-15: Irrigation-Installation/automatic operation of irrigation system as per project design specifications shall occur within forty-eight (48) hours of the installation of palm(s), unless otherwise approved by owner. Palm(s) shall be irrigated so as to maintain a field capacity moisture level for coarse sand. The use of one (1) each twelve (12) inch and thirty-six (36) inch tensiometer installed into the rootzone of a palm considered representative of site conditions is recommended. Varying site conditions may necessitate the use of more than one (1) set of instruments. Contact tensiometer manufacturer for information concerning instrument reading(s) in relation to field capacity moisture levels.

IV-16: Opening of crown-Crown(s) shall remain tied until such time as root re-establishment is noted. It may be necessary to excavate a small portion of the rootzone to a depth of eighteen (18) inches to inspect for root re-establishment. Crown shall be inspected for sign of damage at time of opening.

IV-17: Fertilization-No fertilizer should be applied until the crown(s) are opened (i.e. root re-establishment is noted).

IV-18: Pollution of rootzone-At no time prior to the re-establishment of roots should any material be incorporated into or allowed to pollute the palm backfill material.

Document mention of trade names does not imply endorsement of that product over products containing equivalent active ingredients or those of equal performance. Use of products recommended based on legally prescribed situations. Always consult manufacturers' recommendations and product labeling prior to product use. Recommendations based on sound and accepted horticultural practices. Author cannot be held liable for outcomes or liabilities related to the use of this document for specific projects.

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