November 3, 2021

Mr. Pat Roman
Town of Highland Beach
3616 South Ocean Boulevard
Highland Beach, Florida 33487

Re: Assessment of Roadway Palms

Mr. Roman,

I have performed a limited visual assessment of a population of palms situated in the rights of ways for the Town of Highland Beach. This report is being written per your request. My assignment is to assess the condition of the subject palms and provide recommendations for management. My assessment is limited to the condition of the palms as observed on September 27, 2021. The purpose of this report is intended as a tool to allow the tree owner to make an educated tree management decision. My assessment was performed from the ground. I did not climb any trees or use any aerial lift equipment. No tree risk assessment was performed as this was outside the scope of the assignment.

The subject palms are situated along the Town's rights of ways. This is a coastal community on the barrier island in South Florida. The properties along this stretch of road comprise of single family residences and condominumiums. These buildings vary in height. The palms are just a couple hundred feet from the ocean.

The majority of the roadway palms are comprised of royal palms (*Roystonea regia*). The palms range from a poor to good condition. Many of the royal palms are showing damage to the lower fronds. This damaged is expressed as discolored, frizzled palm fronds. The palms are also showing signs of nutrient deficiency, which is common in South Florida.

The site conditions for this area can be hostile to plant material. Salt spray can be pushed up over the dune and affect plants. The salt desiccates the foliage, creating a "burned" appearance. The soil is primarily sand. These soils lack the specific nutrients that palms prefer, they do not retain nutrients very well so the nutrients often leach deep down into the soil, and the soils are very alkaline and have a high pH.

Different plant species have varying tolerance to salt spray. Some plants have a high tolerance for salt spray and some plants have a low tolerance. Royal palms are reported to have "moderate" tolerance to salt spray. The Florida Native Plant Society list royal palm as having some tolerance to salty wind but not to direct salt spray. Anecdotally, I would suggest that this species of palm is not very tolerant to salt spray.

The exposure of these palms to direct salty winds varies based on its location along the roadway. Some of these palms are well protected by tall buildings. Other palms are very exposed to direct winds coming off the ocean. The direction of the winds also change throughout the year, with winter winds being predominately from the northeast direction. It is very common to observe plants with salt damage in winter along the South Florida coast. Even plants that are reported to have a high salt tolerance such as coconut palms (*Cocos nucifera*) or date palms (*Dactylifera spp.*) show salt damage to the lower leaves.

I would suggest that the damage that can be observed on the royal palms is mostly due to salt damage. They are also showing signs of nutrient deficiency, specifically potassium. Potassium deficiency causes the lower fronds of palms to turn brown and die prematurely. Once the palm fronds are damaged or discolored, that particular palm frond will never recover. The frond will remain discolored or damaged until it falls off or is removed. Palms are genetically programmed to only produce a predictable number of palms fronds each year. It is important to keep the palms as healthy as possible to allow them to retain as many healthy fronds as possible at all times.

Salt damage can be difficult to mitigate. Management would start by selecting plant material that is very salt tolerant. Washing the leaves off with fresh water can mitigate salt burn, but this treatment is time consuming and would not likely be practical on the Town's palms. By promoting good cultural practices, it may be possible to increase the number of live and unaffected palm fronds in the crowns of these palms to improve appearances. Cultural practices would include proper irrigation, mulch over the roots of the palms, and proper fertilization.

Based on my observations I would recommend the following:

- Audit and ensure adequate irrigation based on current rainfall.
- Remove any turf and install a layer of organic mulch to create a tree ring around the palms. Mulch should be installed to a depth of 2 inches.
- Begin a fertilization program as recommended by University of Florida. This would include quarterly application of 8-2-12 or 8-0-12 palm special granular fertilizer applied at a rate of 1.5 pounds of granular per 100 square feet of palm canopy area. Applications should be made every three months and can be supplemented with a granular sulfur product to adjust pH.
- Or, affected palms can be removed and replaced with a species with higher salt tolerance such as coconut palms or date palms.

If you have any questions about my observations or recommendations, please contact me.

Regards,
Jonathan

Jonathan S. Frank
ASCA Registered Consulting Arborist #618
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FDACS Certified Pest Control Operator #JF283138

Limits of the Assignment

The tree assessment was performed from the ground for visual conditions. This tree inventory was not a tree risk assessment. As such, no trees were assessed for risk in accordance with industry standards, nor are there any tree risk ratings or risk mitigation recommendations provided within this report.

Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, the consultant can neither guarantee nor be responsible for the accuracy of information provided by others.

Illustrations, diagrams, graphs, and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.

Information contained in this report covers only those items that were examined and reflects the condition of those items at the time of inspection. There is no warranty or guarantee, expressed or implied, that problems of deficiencies of the plans or property in question may not arise in the future.

There is no guarantee for the preservation of the trees contained in this report, however, the preservation plan is made with the best interest intended for the trees being preserved.

ENH1009

Fertilization of Field-Grown and Landscape Palms in Florida[1]

Timothy K. Broschat[2]

Palms growing in Florida landscapes or field nurseries are subject to a number of potentially serious nutrient deficiencies. These deficiencies are described and illustrated in document ENH1018. Prevention and treatment of these deficiencies is the subject of this document. Chemical symbols used in this document are as follows: N=nitrogen, P=phosphorus, K=potassium, Mg=magnesium, Ca=calcium, Mn=manganese, Fe=iron, B=boron, Cu=copper, Zn=zinc.

Fertilizer Formulation

Nutrient deficiencies are more easily prevented than corrected once they occur. Correction of nutrient deficiencies can take as long as 2 or 3 years for some elements. Research at the UF/IFAS has shown that regular use of a fertilizer having an analysis (the three numbers on all fertilizer labels which refer to their N-P_2O_5-K_2O content) of 8N-2P_2O_5-12K_2O +4Mg with micronutrients can correct mild to moderate deficiencies and prevent their recurrence in most soil types in south and central Florida (Broschat 2015b; Broschat et al. 2008). However, not all fertilizers that have an analysis of 8N-2P_2O_5-12K_2O+4Mg with micronutrients are effective and, if improperly formulated, may be worse for palm health than no fertilizer at all.

It is essential that 100% of the N, K, and Mg in such a fertilizer be in slow release form. Since Florida's soils have very low capacities to retain these elements in the root zone during periods of heavy rainfall or irrigation, the only effective way to keep these elements readily available to plants during the 2 to 3 month interval between fertilizer applications is to use slow release sources (Broschat 1996; Broschat 1997). A water-soluble source applied one day could be completely leached out of the root zone the next day by a heavy rainfall, and the palm would receive no benefit from the application. Controlled-release fertilizers are not greatly affected by rainfall or irrigation intensity. Since they release more slowly than water-soluble fertilizers, they are also less likely to burn plant roots during periods of drought.

Unlike the macronutrients N, K, and Mg that should be in slow release form, most micronutrients need to be in a water soluble form. However, granular slow release forms of boron are safer and more effective for Florida landscape soils.

Effective sources for N include sulfur-coated urea, urea-formaldehyde, resin-coated urea, and resin-coated ammonium salts. Of all the slow-release K sources tested, sulfur-coated potassium sulfate was found to be the most effective and economical (Broschat 1996). Prilled kieserite (a more slowly soluble form of magnesium sulfate than Epsom salts) is an effective and low-cost slow release form of Mg. Coated Mg products tend to release too slowly to be effective (Broschat 1997; Broschat and Moore 2006). Slow release B sources, such as Granubor, are less affected by leaching than the water soluble B sources often used in landscape fertilizer blends (Broschat 2008). The only

1. This document is ENH1009, one of a series of the Environmental Horticulture Department, UF/IFAS Extension. Original publication date September 2005. Revised October 2011, September 2014, and November 2016. Reviewed December 2017. Visit the EDIS website at http://edis.ifas.ufl.edu.

2. Timothy K. Broschat, professor, Environmental Horticulture Department; UF/IFAS Fort Lauderdale Research and Education Center, Davie, FL 33314.

recommended Mn, Zn, and Cu sources are the sulfate forms of these elements (Broschat 1991). Since iron sulfate is rather ineffective on most Florida soils, granular chelated products such as Trachelene Fe are preferred for blending into palm maintenance fertilizers (Broschat 2005).

Another reason why 100% of the N, K, and Mg must be in controlled release form is that the release rate of a nutrient source can determine the "effective analysis" of the blend. If heavy rainfall or irrigation occurs, any water soluble nutrients will be rapidly leached out of the root zone, while controlled-release sources are still releasing nutrients into the soil. This differential leaching of soluble vs controlled-release nutrient sources can alter the effective ratios among the various elements, often with detrimental effects on palm nutritional health. The soil N:K, N:Mg, and K:Mg ratios are very important for palm health, and it is essential that all three elements have similar release rates in order to keep these ratios constant over time.

Fertilizer Application

How you apply a fertilizer can also determine whether the application will be effective or not. Concentrating fertilizer in holes, as spikes, or in bands around the trunks of palms is less effective than spreading the same amount of fertilizer uniformly throughout the area under the canopy. This is because nutrient movement is almost exclusively downward in direction, and thus only that small proportion of the palm root system directly under concentrated fertilizer will ever be exposed to these nutrients. A concentration of fertilizer is also much more likely to burn palm roots than fertilizer spread out over a larger area. Injecting water-soluble fertilizers into the "root zone" of palms is never recommended because 1) water-soluble fertilizers are readily lost to leaching, 2) lateral movement of injected fertilizer is minimal, and 3) injecting any nutrients deeply enough to avoid turfgrass roots will also miss the majority of the palm's fine feeder roots, which tend to intermingle with turf roots near the soil surface.

Although trunk injection of micronutrients such as Mn has been shown to be effective (Broschat and Doccola 2010), this method is not recommended for palms except in cases where soil applications have been ineffective in alleviating chronic micronutrient deficiency symptoms. Since palms lack a vascular cambium and, thus, the ability to heal over wounds in the trunk, any holes created in the process of injecting palm trunks will remain as permanent scars and may provide entry sites for diseases or insect pests.

The 8N-2P_2O_5-12K_2O+4Mg with micronutrients maintenance fertilizer blend described above should release nutrients for up to three months, and thus a three-month application interval is recommended. The suggested application rate for south Florida landscapes is 1.5 lbs of the 8N-2P_2O_5-12K_2O+4Mg with micronutrients fertilizer (not N) per 100 sq. ft. of palm canopy area, bed area, or landscape area. Field nurseries typically apply twice that amount to maximize growth (Broschat 2015b). For landscapes in central and north Florida, winter applications can be omitted and lower application rates may also be adequate, although field nurseries in those regions will probably benefit from the higher south Florida application rates.

Fertilization in Areas where Summer Applications of N and P Are Prohibited

Some counties or municipalities in Florida prohibit the application of P fertilizers unless soil tests demonstrate that P is deficient. In addition, all N and P-containing fertilizers may be prohibited during the rainy months of June through September. Since this is a period when palm nutrient demands and leaching of existing soil nutrients are the greatest, proper fertilization is essential. However, earlier studies have suggested that N may not be as limiting during this warm wet season due to higher rates of natural organic matter decomposition. A recent study has shown that P fertilization may not be necessary at all under most Florida landscape conditions and an 8N-0P_2O_5-12K_2O+4Mg was as effective as the traditional 8N-2P_2O_5-12K_2O+4Mg formulation (Broschat 2015a). This study also showed that if the 8N-0P_2O_5-12K_2O+4Mg product was applied in February, May, and November, but the August application received a similar controlled release palm fertilizer that contained no N or P, then the resulting palm quality was as good as for those palms that received the 8N-0P_2O_5-12K_2O+4Mg product for all four applications. These no N or P palm fertilizers have an analysis of 0N-0P_2O_5-16K_2O+6Mg plus micronutrients. Contact your county Extension agent for information about the availability of these products in your area.

The 8N-0P_2O_5-12K_2O+4Mg fertilizers described above are suitable for all palm species growing in all soil types found within the state of Florida except for the muck soils of the Everglades Agricultural Area. In those soils, sufficient N is released naturally to provide more than enough N for optimum palm growth. However, if the standard 8N-0P_2O_5-12K_2O+4Mg fertilizer is used on these soils, the additional N from the fertilizer combined with that released from the soil can result in excessive N relative to K, Mg, and other elements and could make deficiencies of those elements more severe. In those soils, the $0N-0P_2O_5-16K_2O+6Mg$ formulation described above is recommended.

Use on Entire Landscape

While the $8N-2P_2O_5-12K_2O+4Mg$ with micronutrients maintenance fertilizer described above was developed primarily for the nutritional requirements of palms, other types of plants, including broadleaf trees, shrubs, herbaceous ornamentals, fruit trees, and even turfgrass growing in the same soil are subject to the same inherent nutritional deficiencies in these soils (Broschat et al. 2008). Since palm nutritional requirements are higher than those for other types of plants, a fertilizer that is suitable for palms will be more than suitable for other types of plants. Comparative trials at the UF/IFAS Ft. Lauderdale Research and Education Center have shown that St. Augustinegrass fertilized with the above palm maintenance fertilizer had quality equal to that produced by a high quality turf fertilizer (Broschat et al. 2008).

Use of the above $8N-2P_2O_5-12K_2O+4Mg$ with micronutrients fertilizer is recommended for use on the entire landscape. This not only simplifies fertilization by having to use only a single product, but eliminates a serious problem encountered when high N turf fertilizers are applied to turf areas with palms growing nearby. Roots of large palms typically extend out 50 feet or more from the trunk in all directions and will take up whatever fertilizers have been applied to the turfgrass. The high N:K ratio and the lack of any Mg in most turf fertilizers forces rapid growth in palms, but without sufficient K or Mg to support that growth, this growth dilutes the existing K and Mg reserves within the palm and induces or exacerbates K and/or Mg deficiencies in the palms. High N fertilizers applied to turfgrass, even 30 feet away from a palm on one side only, have been known to kill palms from induced K deficiency. Given the high value of most specimen palms, applying high N fertilizers to the palms or to nearby turfgrass is no bargain, no matter how much less it may cost.

Sometimes it may not be possible to control what kinds of fertilizer are applied within the area covered by a palm's root system. For example, you may have a large palm relatively close to your property line. While you may be properly fertilizing your palm and lawn with the recommended $8N-2P_2O_5-12K_2O+4Mg$, your neighbor may be fertilizing his lawn with typical turf fertilizers that will negatively affect the health of your palm. A recent study has shown that if the turfgrass near a palm has been fertilized with a typical high N:K ratio turf fertilizer, the negative impacts can be prevented by fertilizing the area under the canopy of the palm with the no N or P $0N-0P_2O_5-16K_2O+6Mg$ fertilizer discussed above instead of the usual $8N-2P_2O_5-12K_2O+4Mg$ (Broschat 2015a). This approach may also be more cost effective than fertilizing the entire landscape with $8N-2P_2O_5-12K_2O+4Mg$ for mixed landscapes containing palms and turfgrass.

Treatment of Severe Deficiencies

Finally, while the palm maintenance fertilizer described above is suitable for prevention of all nutrient deficiencies and correction of mild to moderate deficiencies, what can be done to correct existing severe deficiencies? For severe N deficiency, this palm maintenance fertilizer will be adequate by itself, and re-greening of the foliage should occur within a month or two.

When applying K fertilizers to correct a severe K deficiency, it is important to also apply about 1/3 as much Mg to prevent a high K:Mg ratio from causing a Mg deficiency problem. For severely K-deficient landscape palms, broadcast a 3:1 blend of slow release potassium sulfate and prilled kieserite uniformly to the soil under the canopy at a rate of 1.5 lbs per 100 sq ft of canopy area. A slow release palm fertilizer like the $0N-0P_2O_5-16K_2O+6Mg$ mentioned above works well for this purpose and is more readily available than slow release potassium sulfate and kieserite. This application should be repeated in three months. Three and six months after that, a 1:1 mixture of the $0N-0P_2O_5-16K_2O+6Mg$ and a $8N-2P_2O_5-12K_2O+4Mg$ palm maintenance fertilizer should be substituted at the rate of 1.5 lbs of fertilizer per 100 sq ft of canopy area. After one year, use only the $8N-2P_2O_5-12K_2O+4Mg$ palm maintenance fertilizer at the same rate.

Treatment of K deficient palms typically requires from one to three years or longer, since the entire canopy of the palm will need to be replaced with new, symptom-free leaves. Potassium-deficient palms support fewer leaves in their canopies than K-sufficient palms, and the symptomatic older leaves will not be eliminated until a full, rounded canopy of leaves has been produced (Broschat and Gilman 2013). Removal of discolored older K-deficient leaves on a regular basis has been shown to accelerate the rate of decline from this disorder and can result in premature death of the palm (Broschat 1994).

Treatment of severely Mg-deficient palms can require a year or more and is accomplished by broadcasting a controlled-release magnesium source (prilled kieserite is an excellent source) at rates of 2 to 5 pounds per tree 4 to 6 times per year to the area under the canopy. This treatment is to be considered as a supplement to regular applications of a balanced 8N-2P_2O_5-12K_2O+4Mg palm maintenance fertilizer. To reduce the potential for salt injury, Mg and maintenance fertilizer applications can be offset by six weeks.

For Mn-deficient palms, soil applications of manganese sulfate are effective, but spraying the foliage with this product may achieve more rapid, though short-term, results, especially on alkaline soils. This should be considered as a supplement to soil applications, not as a replacement. Manganese sulfate solutions to be applied to the foliage can be made by mixing 3 lbs of this product in 100 gals of water.

Soil application rates are dependent on palm species, soil type, and severity of Mn deficiency. These rates will range from as low as 8 oz for a small palm or one growing on an acid sand soil to 5 lbs for a large species growing on a limestone soil. Broadcast this product over the soil under the palm canopy. Applications can be repeated every 2 to 3 months, depending on the severity of the problem and soil type, but a response may not be seen until 3 to 6 months after applications. Avoid using composted sewage sludge or manure products near palms (Broschat 1991). Excessive Mn applications normally result in an induced Fe deficiency, with its characteristic new leaf chlorosis.

For treatment of Fe deficiencies, soil applications of iron sulfate are generally less effective than some of the chelated compounds such as FeDTPA, FeEDDHA, or FeHEEDTA, because free Fe^{++} ions are rapidly oxidized under most soil conditions to the less soluble Fe^{+++} form. On alkaline soils, FeEDDHA is the most effective product, followed by FeHEEDTA and FeDTPA (Broschat and Elliott 2005). FeDTPA is the most effective product for foliar application, but it is important to note that all of these chelates can be phytotoxic to palms and other plants when applied at high rates. Follow application guidelines on the label for these products. Keep in mind that most Fe fertilizers can cause brown staining, so take precautions to keep them away from non-target objects.

Fertilization to correct or prevent B deficiency in palms is problematic at this time. The most common B sources used on palms are water soluble sodium borates. In high rainfall climates, such as that of Florida, an application of water-soluble B can be completely leached out of the root zone with a single heavy rain shower. Slow release B fertilizers such as Granubor are an obvious solution to this problem because they release over a 3 to 4 month period (Broschat 2008). However, appropriate application rates for this product on palms have yet to be determined. It is extremely important not to overdose palms with B fertilizers since the difference between deficiency and toxicity levels of B is rather small, and correction of a B toxicity caused by over-application of slow-release B fertilizers could be very difficult.

Current recommendations for correcting B deficiencies in palms are intentionally conservative because of the potential for toxicity. Dissolve about 2–4 oz of Solubor or Borax in 5 gallons of water and drench this into the soil under the palm canopy (Dickey 1977). Do not repeat this for at least 5 months because it will take this long to see the results of the first application.

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Not All Landscape Palm Fertilizers Are Created Equal[1]

Timothy K. Broschat[2]

Palms are widely planted in Florida landscapes throughout the state, especially in the central and southern parts, for their aesthetic effects. Their bold leaf textures create a tropical or Mediterranean look that is highly desired by residents and tourists alike. However, palms have very high nutritional requirements (see *Nutrient Deficiencies of Landscape and Field-Grown Palms in Florida*, http://www.edis.ifas.ufl.edu/ep273), and deficiencies of any nutrient element can result in highly conspicuous and unattractive symptoms on their large leaves.

Sixteen elements are required by palms for normal growth: carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B), molybdenum (Mo), and chlorine (Cl). Of these, N, K, Mg, Fe, Mn, B, and occasionally P often are deficient in Florida's sandy, calcareous, and organic soils and must be added as fertilizers to prevent or correct deficiencies in landscape or field-grown palms (see *Fertilization of Field-Grown and Landscape Palms in Florida*, http://www.edis.ifas.ufl.edu/ep261). One of the problems encountered when fertilizing plants is that some nutrient elements are antagonistic to others, so that too much of one element could induce or exacerbate a deficiency of another.

The optimum amounts and ratios in fertilizers of the seven frequently deficient elements for landscape palms in Florida have been experimentally determined to be 8N-0 or $2P_2O_5$-$12K_2O$-4Mg plus about 2% Mn and Fe (0.1-0.2% if chelated), and 0.15% of B, Cu, and Zn (hereafter referred to as 8-2-12-4Mg), but note that 8-0-12-4Mg also is acceptable (Broschat 2009, 2015). However, just because a fertilizer has this analysis does not mean that it will be effective. The source of each individual element is just as important. Landscape fertilizers are mixtures or blends of 8 or more individual nutrient elements, and a number of different sources of each of these elements are available. Some of these sources are completely insoluble, some are slowly soluble or controlled release, and some are completely soluble. Thus a large number of possible combinations of these various elemental sources could be created. Some of these blends could do great things for your palms, some might do nothing at all, and some might induce or exacerbate deficiencies rather than correcting them and possibly kill the palm over time.

Plant nutrients must be in a water-soluble form for plant roots to be able to take them up, and their solubility often is regulated by soil pH. For example, the solubility, and thus plant availability, of micronutrients such as Fe and Mn drops off rapidly as pH increases (Lindsay 1972). Under these conditions, the most effective fertilizer sources for these elements are the most water-soluble ones. For Fe, Mn, Zn, and Cu, sulfates are commonly used and are effective, but chelates of Fe such as EDTA and DTPA are even more effective than the sulfate form (Broschat 1991; Broschat and Elliott 2005). Unfortunately, due to their lower costs, some fertilizer manufacturers use oxides or sucrates (essentially molasses-coated oxides) of these elements. These compounds have been shown to be almost completely insoluble

1. This document is ENH1255, one of a series of the Environmental Horticulture Department, UF/IFAS Extension. Original publication date March 2015. Reviewed December 2017. Visit the EDIS website at http://edis.ifas.ufl.edu.

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in neutral to alkaline soils, and even in acid soils they are solubilized so slowly that they do not provide adequate amounts of these elements to palms (Broschat 1991; Broschat and Elliott 2005).

On the other hand, many commonly used fertilizer sources of N, K, Mg, and B are highly soluble in water and are thus highly leachable through Florida's sand and calcareous soils which lack significant cation-exchange capacity. For these elements, slow-release (slowly soluble compounds) or controlled-release (coated soluble compounds) sources help keep these nutrients available to the plant over a longer period of time under leaching conditions (see *Controlled-Release and Slow-Release Fertilizers as Nutrient Management Tools*, http://www.edis.ifas.ufl.edu/hs1255). For difficult-to-treat deficiencies such as K deficiency, simply increasing the amount of water-soluble K applied has not been effective, since large amounts of water soluble K are just as quickly lost to leaching as are smaller amounts. The only way that K deficiency can be eliminated in most Florida landscape soils is through the use of controlled-release K sources like sulfur-coated potassium sulfate. While resin-coated fertilizers generally are considered to be superior to sulfur-coated materials, the release of K and Mg from resin-coated sulfates has been shown to be too slow to be effective, compared to N sources prepared with the same coating (Broschat and Moore 2007).

Since oxides and carbonates of Mg are too insoluble to be useful sources of Mg, and resin-coated magnesium sulfate releases Mg too slowly, the best controlled-release source available at this time is kieserite, a naturally-occurring, slowly soluble form of magnesium sulfate (Broschat 1997). While soluble forms of B such as Borax® or Solubor® have been used in blended fertilizers, their high solubility makes them readily leachable under typical Florida landscape conditions. Furthermore, these materials are powders that quickly settle to the bottom of the bag when blended with granular fertilizers. This means that fertilizer taken from the top of the bag could contain too little B, while that taken from the bottom of the bag could contain toxic amounts of B. Studies evaluating a number of slow-release forms of B have identified Granubor® as the best material for blending since it has a granular form and releases over a three-month period, like sulfur-coated potassium sulfate (Broschat 2008).

While it is important to have the correct ratios of the various elements in a blended palm fertilizer, if the wrong sources are used those ratios can change over time due to differential leaching of the more soluble components. For example, an 8-2-12-4Mg palm fertilizer having N in controlled-release form but K in water-soluble form might initially have the correct N:K ratio, but over time the water-soluble K will be leached out of the root zone while the controlled-release N source continues to provide N to the palm. This N will stimulate new growth, but since there eventually will be no new K to support that new growth, the amount of K already in the palm will be diluted among a larger number of leaves, thereby reducing the concentration of K and resulting in more severe K deficiency symptoms than prior to fertilization. A similar situation could occur if the K source is controlled-release but the Mg source is water soluble. Over time, the water-soluble Mg will be leached out of the soil but K will still be available from its controlled-release source, upsetting the effective K:Mg ratio in the soil. Thus it is essential not only to provide the correct elemental ratios initially, but also over time by matching the release rates of the controlled-release sources of the N, K, Mg, and B (Broschat 2009).

How can you tell if you have an effective 8-2-12-4Mg palm fertilizer? Unfortunately, examination of fertilizer labels can be more misleading than helpful due to the terminology used and the types of testing done on fertilizers by state regulatory laboratories, all required by Florida fertilizer laws. For example, a fertilizer containing only coated N or K will appear on a Florida fertilizer label as being 100% water soluble due to the fact that water-soluble sources are enclosed within the coating and the coatings are crushed in the laboratory testing procedure.

Our research has shown that the most effective fertilizer has 100% of the N, K, Mg, and B sources in slow-release or controlled-release form and all of the Mn, Fe, Zn, and Cu sources should be water soluble (generally these will be sulfates, except for Fe, which can be chelated with EDTA or DTPA) (Broschat 1991a, 1996, 1997, 2009; Broschat and Elliott 2005). To determine if a fertilizer contains the correct nutrient sources, examine the ingredients section of a fertilizer label (it may be called "derived from" or something to that effect). Look for any source of N, K, Mg, or B that is water soluble. If any are present, then 100% of those elemental sources cannot be slow release and thus the fertilizer does not meet our specifications. Although activated sewage sludge is considered a slow-release form of N, it should never be used in palm fertilizers as it can induce severe Mn deficiencies in palms and other ornamental plants (Broschat 1991b). For the remaining micronutrients, look for water-soluble sources such as sulfates or chelates, but avoid oxides or sucrates if they are the sole or primary source of Mn and Fe. Table 1 lists the most effective sources for the seven critical elements in Florida landscape palm fertilizers.

For Mg, it can be difficult to tell if the magnesium sulfate listed on the label is the slow-release form called kieserite (magnesium sulfate monohydrate) or the very soluble form known as Epsom salts (magnesium sulfate heptahydrate) unless the manufacturer indicates this somewhere on the label. If this information cannot be obtained from the manufacturer, a simple visual examination of the material will reveal the presence of kieserite, since it will constitute a significant proportion of the blend. Kieserite is creamy white and is the largest granule in the blend, making it very conspicuous (Figure 1).

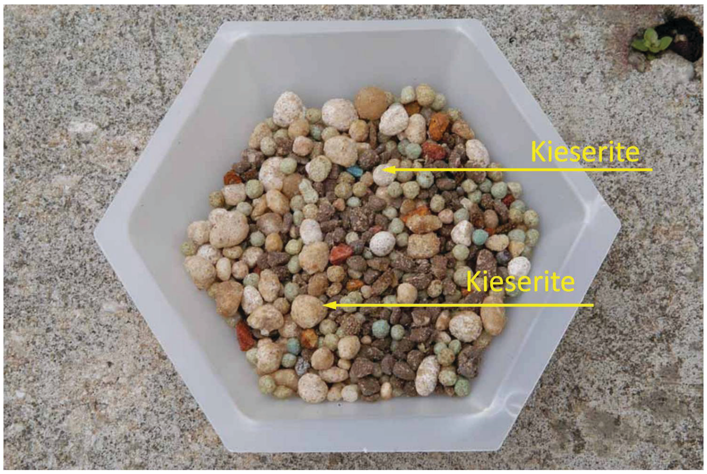

Figure 1. A sample of an 8-2-12-4Mg landscape palm fertilizer showing the conspicuous granules of kieserite, a slow release form of magnesium sulfate.
Credits: T. K. Broschat, UF/IFAS

Similarly, it can be difficult to determine if a powdered, water-soluble form of B like Solubor® or Borax® is used or if the product contains the slowly soluble Granubor®. All of these materials are sodium borates, so one must inquire about which form is included if the label does not indicate the source.

Finally, it should be apparent from the above discussion that 8-2-12-4Mg palm fertilizers can be formulated in more than one way. Unfortunately, the most effective sources of most of the critical elements in palm fertilizers also are more expensive, so some fertilizer companies make products which superficially meet our specifications (e.g., have the correct analysis), but upon closer examination do not. They have substituted some or all of the required controlled-release N, K, Mg, or B with water-soluble sources and have used insoluble micronutrient sources like oxides or sucrates to reduce costs. Thus if you request bids for the lowest-cost 8-2-12-4Mg palm fertilizer you likely will end up buying a formulation that will not be effective and may make your palms look worse than if they had never been fertilized. **The only way to ensure that you will be getting an effective fertilizer is to specify that 100% of the N, K, Mg, and B sources are slow release and that the Mn, Fe, and other micronutrients are present in sulfate or chelated form.**

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Table 1. Effective fertilizer sources for blending Florida landscape palm fertilizers with three-month release rates.

Element	Recommended Sources[1]
N	Sulfur-coated urea, resin (or polymer)-coated urea or ammonium salts, urea-formaldehyde
P	Superphosphate, triple superphosphate, coated diammonium phosphate
K	Sulfur-coated potassium sulfate (may have additional polymer coating)
Mg	Kieserite (magnesium sulfate monohydrate) granules
Mn	Manganese sulfate
Fe	Iron sulfate, FeEDTA and/or FeDTPA
B	Granubor® (sodium borate)

[1] Based on data from Broschat (1991, 1996, 1997, 2008) and Broschat and Elliott (2005)