Andrew Koeser - Remove or Retain: Research and Anecdotes Surrounding Wire Baskets.

This transcript is auto-generated. Please direct any questions to isa@isa-arbor.com.

[00:00:00] **Tom Smiley:** [Introduction music playing]. Welcome to the ISA Science of Arboriculture Podcast series. This is Dr. Tom Smiley at the Bartlett Tree Research Laboratory, host of this podcast series, which is brought to you by the International Society of Arboriculture and the FA Bartlett Tree Expert Company.

Today's podcast is by Dr. Andrew Koeser, who is an assistant professor of environmental horticulture and landscape management at the University of Florida in Tampa. He is speaking on his research and experiences with the removal of wire baskets from new transplants in the landscape.

Andrew Koeser: [00:00:51] Hello, everyone. Thanks for joining me today. My name is Andrew Koeser. I'm at the University of Florida outside of Tampa in Florida. Today's talk will be “Remove or retain: research and anecdotes surrounding wire baskets”. Not so much of a thing where I am now in Florida, but where I grew up and where I studied in the Midwest, where baskets were kind of the norm and the controversy surrounding them has been along for quite a while. And we'll talk about that today.

First, I'm going to start off with a little bit of a side note, a little just a cool thing I found when we're walking around Tampa one day. I saw this big Oak, this big live Oak. And of course it caught my eye. As I walked over to it, I saw this plaque next to it, “National Arborists Association”, if you are newer to the industry is now TCIA and this ia a joint plaque from both the organizations ISA and TCIA saying that they'd recognize this tree was significant as having witnessed Tampa grow from a population of 5,500 to the thriving city that is today in 1997, again 13 years in the past. So this tree is going long [00:02:00] and strong. And Tampa is now 400,000 people. So quite a bit of growth has happened around this tree. This tree has persisted for a long time. And when we plant trees, this is what we're shooting for. We want this longevity, we want trees to get a good start and persist for as long as possible. Because that's when payback the most environmental benefit.

But what are we clear baskets have to do with all this? You know, there is competing thoughts on the subject, within the industry and within the green industries in general. A lot of folks, especially folks in the nursery industry who have no control over trees after they leave their facilities, worry that wire basket removal and removal bald of burlap and materials will kill a tree.

At the same time, people who work with trees in the landscape, arborists and landscapers, worried that not removing the wire basket in the burlap will kill the tree. So having diametrically opposed viewpoints is rare. Especially when we're all looking this same evidence, maybe not so rare as it used to be. And that raises a question that is worth investigating the research.

So why do we use wire baskets? They were developed specifically for tree spade use on the mechanization of field nursery production. They're faster and stronger than drum lacing, which is the art of tying up a ball, a root ball with rope. And, and it's, it's a very beautiful thing if you've seen it. But it just takes too much time and too much labor, which is a cost for green industry production.

The wire baskets very strong and you can use it to maneuver trees at the planting hole. We don't want to put any pressure on the trunk, especially when we have these multi hundred pound, multi kilograms soil balls that could weigh down the trunk and snap it.

And wire baskets are specifically really good at allowing nurseries to grow on land that maybe they couldn't use before, specifically sandy and [00:04:00] gravelly or nursery soils.

What are some arguments for the removal of tree wire baskets? First there's the fear that wire basket removal will lead to girdling or partial girdling of the root system. And this is something that was addressed in part by some research by Glenn Loomis at the University of Guelph in Canada. When he looked, and I'll show you a little bit more of this study in the future, about willow on his campus and their ability to fully engulf and grow past wire and resume function of their vascular systems.

Even if girdling isn't a problem, folks worry about the long-term instability of trees. Here's a picture Gilman at my university, retired professor at University of Florida, where he found cracks forming where the wire was in contact with a root material. And that could be a source of long-term instability if it becomes a problem and weakens the root wood.

And then there's also issues and concerns of safety. You know, trees eventually die, even the longest lived ones. And if the wire basket can persist for decades, like some people believe and have witnessed then what do you do about stump grinding when you have that metal embedded in the stump of a tree.

And finally given all this, you know, a lot of cities and governments are already putting it in the specifications that wire baskets need to be removed and granting organizations such as Indiana Forestry, I think to have that in their specs as well. So if you're not doing this, you're in violation of specifications that are existing for the work.

Arguments for retention. You know you know, sandy, gravelly soils; once you remove that burlap and the material, the root ball is extremely fragile, heavy and can break apart. Normally we suggest that you don't remove any of this [00:06:00] material until the ball is actually in the hole. But even then as this picture shows from our study, I mean you can have some issues with the root ball cracking and disrupting what little limited root system is remaining in this tree.

Also when you removed the root ball, that root balls is a huge anchor for bald and burlap trees, but if it's not intact they you may need to produce or use supplemental stabilization measures to keep a tree up right. Especially if you have winds or in that kind of critical of transition where the leaf material starts coming out in the first Spring flush and the roots have not established in the surrounding soil.

Also, there's a concern of added labor. If this does not do anything, and that's a concern of some folks aren’t exactly detrimental, you're adding labor costs to a planting process for no good reason. And finally, some reasons for retention is that some nurseries are actually still concerned about this. They will not honor warranties for trees where burlap has been removed and where wire has been removed on their trees.

So there has been one kind of critical look into this topic in the peer review. And it was by Bonnie Appleton and Charlene Floyd in 2004, where they looked at all the research and all of the recommendations that were in both peer review and professional literature on the topic. It's a pretty comprehensive assessment of the literature, but as you see here, if you actually look at the peer reviewed research in this lit review, there are only two studies out there.

One by Glen Lumis and a student, and another one by Lumis again, later on in the eighties and nineties.

The first study was by Lumis in 1988, and this [00:08:00] was an assessment of campus trees on the University of Wealth. And they looked specifically at some 11 year old willow that have been planted with the wire and tact and did kind of a visual observational assessment of them. Not many reps in this study, more of an observational ad hoc thing.

But in doing so in this really short article that they published in [indistinguishable] *Science*. They found that there was full enclosure of the wire and that they suspected that there was restoration of the vascular function and that it was likely did not test it in this study. But despite this, they concluded that concerns over the effects of wire baskets being detrimental for the long-term health of trees might be overstated.

Then the second study by Lumis and Goodwin and Lumis, was actually four years later. And this was more of a, an intentional study. It was in a greenhouse and what they did is they took seedlings that were Hackberry, Willow, and Ash, and actually intentionally girdled them with appropriately sized floral wire to simulate this kind of girdling that could occur if wire baskets who left intact and doing this, they found that only in the full girdling treatments as shown in this picture, that you see a significant difference in leaf, dry weight for girlded Ash. They did not see any differences in whole plant weight differences after one year overall for all three species, but they did detect one significant response.

And that was in leaf. Dry weight into the girdled ash, as I mentioned. So they, they noted in this study that this was kind of a model system and an extrapolation of the findings from a single season experiment would be difficult given the longevity of trees in the landscape. However, they had the same conclusion that they had in the original study in that they felt that [00:10:00] the concerns were probably overstated, especially when you considered as much as 98% of the root system could be lost when transplanting balled in burlap trees.

So given this, there isn't any real conclusive research out there showing that leaving or retaining a wire basket in the burlap material is detrimental or beneficial or neutral.

When you have these gaps in literature there's need for further investigation. And that's something that Tree Fund found. That they could support when they first supported our study that I'll mention in the next slide. Oh, but despite that, and despite not having any conclusive evidence, you know, folks are still making recommendations.

This is actually an infographic that Bonnie Appleton developed, the late Bonnie Appleton, so I'm not trying to pick on her. I want to be very clear about that. After that lit review and I found it surprising that she included in this list of "24 ways to kill a tree", retention of the wire basket, as one of the

things that you could do to kill a tree, kind of a tongue in cheek infographic. Others take a, more of a reserved and conservative approach to this.

This is Ed Gilman's work. Some guide that he put together after the hurricanes of 2004 in 2005, showing how to properly plant trees and reforestation efforts. And he wrote that there is no research documenting the detrimental effects of wire baskets on trees. If you decide to remove the wire do so after the tree is in the hole and stabilize the tree to prevent overturning.

If you look, there's a lot of different best management practices and advice that would go across the board. This is a list that was compiled by Mike Coons, who's researched things like wire baskets and burlap in the past. I'll show you some of that later on, but he's found that the Forest Service suggests cutting and removing wire and cutting the strings in the burlap to expose the root ball. ISA and its [00:12:00] BMPs and study guide say to the cut and remove string and wire from the trunk and the top third of the root ball. Alex Shigo the former researcher at the US Forest Service and father of arboriculture, suggested removing the string and pulling back the burlap to see if the roots are even present. The Arbor Day Foundation they recommend after the tree has been placed in the hole to remove the wires and then other guides, all kind of suggest some sort of removal despite a lack of evidence supporting it.

Again, we felt the need to investigate this. This is a work by myself, Richard Howard University of Wisconsin, Stevens Point. Jeff Edgar, a nursery grower in my home county of Manitowoc county, Wisconsin, and then Dave Klein, who's in from the twin cities area, another nursery grower and landscaper.

This was a kind of an academic and industry collaboration. We looked at three different levels of burlap removal and wire removal. Ranging from intact, which was an “A”. A partial removal, which was the top third that ISA recommends for “B”. And then a full removal of the burlap in “C”. As I mentioned, our first location was in Manitowoc, Wisconsin, which is along Lake Michigan, my hometown.

This was done back when I was in grad school and I had a lot longer and less gray hair. The other study was in the twin cities area. And it was conducted actually the year after the first one in Manitowoc. But we combine the results for this study. We looked at Norway maple and honey locust. Norway maple to be having a deeper root system than honey locust. We want to see if there was an impact of that. And then our treatments, again, as I mentioned, full removal, partial removal, and fully intact.

To remove the wire we did have what I will call the Howard [00:14:00] Werner method. Just because it, that's kind of one of those ridiculous things that academics do is just a joke.

But what I was taught at Stevens Point when I was a student, there is that if you remove the bottom of the basket first, while the ball is outside the basket, the natural taper, or will kind of create a taper and allow you to move it into the hole where you can remove the rest of the basket and get the entire thing off, not just the top third. So for our full removal treatment, this is what we did.

We measured time to plant. Visual root ball or visual root ball rating of any damage such as the stuff that you see in the bottom picture. We measured caliper growth every year. Twig elongation on three low sun exposed branches.

We met SV a chlorophyll fluorescence, which is essentially a fancy flashlight and you flash it on the leaf. And if a leaf is healthy and the tree is not stressed, it'll use that light for photosynthesis. And if the tree is stressed, a lot more light will bounce back and the sensor will catch that and show you how stressed the tree is.

And then finally, we looked at rooting and strength. Much later on do some static pull testing. So here's our destruction scale. We're looking at zero, which is no disruption of the root ball, to five, which has complete bare rooting. And here are our results. We're looking at growth and stress in this table.

We have our treatments which are “intact”, “partially removed”, “full removal”. For a Norway maple and honey locust at the both sites, and we're comparing our caliper growth, our annual twig growth and our chlorophyll florescence measurements.

If you look here, this is what I would call a sea of statistical non significance, which is kind of disappointing as a grad student. But I [00:16:00] also see it as optimist that this is what I call the “you can't lose study” where if you were pro-removal or pro-retention, you are, you are right either way. So everyone should be happy.

The one significant finding we did have was one of the groups of Norway maple at the forest lake Minnesota site. We did see a slight difference in our treatments for chlorophyll fluorescence, that stress measurement. I chalk this up to just a false positive, honestly. When you see this trend of overall non-significant, but you have all these comparisons being made. I don't see this being overly significant and the numbers kind of play out as that way.

Overall, the, the trees in our Manitowoc site were slightly more stressed than the ones in the Minnesota site. The ones in the Minnesota site, we're kind of at the range where we would expect healthy non-stress shade used to be at where we have some droughty or conditions at the Manitowoc site in the course of this initial study period, which was three years.

One of the things that we mentioned earlier, as a reason that removal was not recommended among practitioners was that it can be a cost as far as labor is concerned. So we did a planting trial where we just looked at the added time, it took to remove the basket in the entire process of planting. So we had a stopwatch and it was like, how long does it take us to remove this material for each of our treatments? And we found that on average partial removal added 2.5 minutes to the planting time. And that was about the same for full removal. And there was really no difference between partial removal or a full removal. They were both equally as fast or as slow, I guess in this case. So looking at RS means data on how long you'd expect to plant the entire tree.

That 2.5 minutes was 3.2% of the labor [00:18:00] associated planting, or a cost of $5 and 58 cents, which is about the, the cost of a summer Baconator at Wendy's. So not a huge investment. It's something you could definitely pass on to the homeowner or whoever is contracting the work to be done.

Okay. So this still doesn't answer the question, you know, as I said, this is the “everyone wins” study and that doesn't make people happy, especially if they have a dog in the fight and they wanted to be pro-removal or pro-retention. Here again is a an article posted on Mike Marshal's website, Marshall Tree Farms. Where he mentioned that, you know, leaving the basket intact is beneficial, especially if

you are in hurricane or storm-prone areas like Florida, because they've seen that these treatments tend to keep the tree operate in heavier winds.

I just say that we experienced something very similar storm hit our Minnesota site three weeks after planting. And we noticed some overturning, which was corrected very quickly. And we did not see any changes in growth on because of this. We recorded and kind of tried to capture that in our analysis to make sure that there wasn't any confounding. So after this first study, I presented my results at the Iowa Shade Tree short course, and when I was there Bob Bleacher from Eagle Nursery in Nebraska, came up to me and said that he had started a study nine years earlier with the University of Nebraska looking just at this question. And unfortunately in the time that he'd been monitoring these, the professors that started the study had retired. So he was looking for someone to help them analyze the data and I was happy to help obliged, given my experience with the research material.

In this study and this study 45 bottom purple fractions, Americano [00:20:00] trees. Which are white Ash, were planted in a random arrangement that even Bob didn't know until we got the data key from the folks at University of Nebraska. Trees were tree spaded only. So no materials were used at all. They were planted BNB with everything removed from the top, and then they were BNB with everything removed in general. And they measured caliper height and survival over eight years.

Just like our first study, I didn't mention this, but all the trees survived in both studies. The only significant difference in growth was with height. And it was just marginally significant or non-significant depending on if you're an optimist or not at 0.05 or 0.07. So 0.05 is a common threshold for statistical significance and it was just right below that threshold. In contrast, caliper growth was not significant and really not significant at.30.

Height growth. So as I mentioned before that this was kind of marginally significant, given our treatments. You can see there was a little bit of a gap in years two, three, and four. But as after a while, they started to converge on each other again, and the treatments were not significant.

Caliber growth. You know, there was, it was very similar in the earlier part of the study. Then you started to get a divergence, I guess at years 5, 6, 7, and eight. So we looked at this data and specific to see if that the signal from these years from not being washed out by the whole data set.

But we still did not find a significant difference, even as things started to separate with the full removal being slightly bigger in diameter, than the wire intact, in the [00:22:00] full removal. So with that, we had short-term results from the Wisconsin and Minnesota study, about three years.

And then we had this longer eight year study, or nine year study as it came out to be when we finally got all the data collected because we did one more year after what I showed you. We decided to revisit the stuff from Manitowoc and Minnesota, do some more growth measurements and then do the final assessment of rooting strength by using some static pull testing.

Okay. This is a static pull set up. This is one that we used in another study, but it's very similar to what we used in our two studies mentioned. Where we just have a simple, in line load cell, pulling to the tree to one degree, which we use a digital caliper for, and then measuring the force, and then calculating the bending stress based on the diameter of the stem. It kind of normalize everything

because if you don't normalize for diameter, you know, things that are a little bit thicker, it will be fear will seem tougher than things are a little bit more slender.

So as I mentioned, that we kind of staggered these studies with a Manitowoc one was a year before, so this data is five or six years old, depending on the site. And we pulled these things to one degree to see how, or if there was any difference in their rooting strength. The results of this study, which is currently under review for the *Journal of Environmental Horticulture* and should be published and ready to show very shortly, is that, you know, we did have a difference in twig elongation between the species, but no difference among the treatments, even after the longer five-six year timeframe.

Looking at our caliper growths, we had a similar divergence that we saw in the [00:24:00] Nebraska trees. That over time, you know, we were starting to see the, in this case, the partial removal kind of getting a little bit thicker then our intact or our full removal. Again, not significant, but a trend and worth noting, especially since you know, these trees were all sacrificed at the end of the trials so we really can't follow up to see if it would continue to spread over time.

Norway maple, we did not see any such divergence, so there might be a species kind of effect in their ability to cope with any stresses that are occurring below ground.

Speaking of stress, pending stress, or our anchorage measurement, we did not find any difference among our treatments again, although the full removal, there was a slight uptick, not significant, in the honey locust. And there was a significant difference between the two species, as you can see here in these results. With the the honey locust being a little bit more strongly rooted than the Norway maple.

So the question is, you know, we have these diverging opinions. Our research didn't give us any conclusive findings that would say one was right or the other.

I kind of think in my mind, you know, if people can have opposing views on the same topic, there may be, is no clear, you know, no clear pattern. Especially with all the trees are planted, all over this country. We're not seeing anything clear, like we solve stem girdling roots and other issues that came to light over time.

But if there truly is no problem with keeping the wire basket on, where did this reputation come from? And I think maybe there's some confounding with the burlap itself. For a while, synthetic burlaps were being used quite a bit and researched by Michael Coons and others has shown that, you know, that can be [00:26:00] something that impedes root growth into the surrounding soil.

And in study they suggested actually moving something for a lap and he was a picture from Gilman showing kind of the results played out in the landscape. And also I think that there's kind of a symptomatic, you know thing happening here. When you see a tree that's dead in landscape and, and you go to remove it and see that the wire basket and the burlap are completely intact and that tree hasn't grown any roots, you think this bear lap in the wire killed the tree. Right? And it makes sense, but is it really a causal relationship or is it symptomatic of the soils, which are so poor that not only do they not degrade burlap and they don’t degrade metal. They're not allowing for root growth to occur, you know, and that could be a case.

This is a *Landscape Below Ground*. I think it's the first one published in 1994 of the proceedings and they actually were using metal rods on, you know just kind of steel rods, just like you would use for the same material that you're using the wire basket to gauge how good a soil was. If the steel rods were rusting, it was a sign the soil was productive and good. based on the level of deterioration.

Some caveats to this study, we did remove any burlap and rope that were right around the trunk of the tree. Because we noticed after the first growing season for Antech treatments, that they just, it wasn't degrading fast enough and we made the judgment call that we had to remove anything around the trunk because we want to prevent girdling.

I would say that that is definitely something that needs to occur based on our experience. Also you know, nine years is long from a research point of view. Most, you know, most graduate students are in it for two to four years, and that's kind of by default the lifespan of many projects in our field. [00:28:00] But it's still not long yeah. In the life of a tree that could live for decades and decades. I think more research can be done based on existing planting records and have to have good records on how things were done. And when BMPs kind of came in and look at things observationally over larger samples in larger populations of trees to infer some sort of trends if possible.

And with that I didn't solve the problem. I didn't solve the controversy. I think that we didn't see anything, you know, in the short term. I think there's no evidence to suggest that wire baskets need to be removed or retained. It only time will tell.

Tom Smiley: This concludes Dr. Andrew Keoser's talk on "Removing or Retaining Wire Baskets from New Transplants in the Landscape". His talk was originally presented at the 2020 ISA Virtual Conference. The views and information expressed are those of the speaker. Please join us next month for another presentation in the ISA Science of Arboriculture Podcast series. [Closing music].