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# Review and Propagation of the Holly Slope

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An independent study project report by The Martha J. Wallace Endowed Plant Propagation Intern (2013-2014)

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## **Abstract**

The purpose of this project was to complete several goals that contribute to a long-term ongoing renovation of the Holly Slope section at the Morris Arboretum. The first of these goals was to perform an assessment to determine if any of the hollies on the slope are rare or unique. This goal was completed by contacting nine other major holly collections to provide lists of their plants. Following the assessment, the next goal was to propagate those hollies with the eventual intention of offering specimens to other gardens and arboreta. The results of this work will contribute directly to future goals for the slope, including determining which holly plants can be removed to reduce crowding in order to revitalize the collection and opening up some areas to interplant the hollies with live oaks (*Quercus virginiana*). In addition to the previously mentioned efforts, this paper will explore a brief history of hollies and provide some general information on the taxonomy and botanical description of the holly genus, *Ilex*. It will also look at the evolution of the holly collection at the Arboretum, particularly on the holly slope, and discuss propagating hollies from cuttings. Finally, there will be a look toward the future of being able to put the findings of this work towards making changes on the Holly Slope.

## **Disciplines**

Botany | Horticulture

## **Comments**

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## INTRODUCTION

Hollies are plants with a long horticulture tradition that are known and recognized by many gardeners. Like any other industry, horticulture has trends and in recent years, hollies have often been snubbed in favor of plants that are newer to the nursery trade. Despite often being overlooked these days, hollies are still plants with much horticulture value and deserve to remain an important part of our public and private gardens.

The holly collection at the Morris Arboretum, particularly in the area known as the “Holly Slope,” has been a site of ongoing renovation since 1999. This ongoing long term project has many objectives, and my contribution towards the work on the Holly Slope involved several interrelated goals. The first of these goals was to determine if any hollies on the slope are unusual, special, or rarely present in other major holly collections nearby. This assessment was completed by way of correspondence with the staff at the institutions that house these collections. The next goal was to propagate the special hollies with the eventual intention of offering specimens to other gardens and arboreta who may be interested in building up their own holly collections. Propagation of these plants by cuttings was undertaken in the winter of 2013-2014, and they are currently growing in the greenhouse at the Arboretum.

This project also contributes directly to some future goals of the larger Holly Slope renovation; it sets the stage for determining which holly plants can be removed to reduce crowding on the slope to revitalize the collection. The information from the assessment will be helpful in making decisions about what plants should be removed. If it is decided that any of the special hollies have to be removed, they will have already been propagated and growing in the greenhouse. Opening up space on the Holly Slope is an important aspect of another related goal in the larger renovation project: interplanting the hollies with live oaks (*Quercus virginiana*). These beautiful, majestic evergreen oak trees are iconic of the southeastern United States, but are not hardy in Pennsylvania. The Arboretum’s director of horticulture and curator, Tony Aiello, collected acorns from live oaks in the northernmost part of their natural range in the hope that the resulting plants would be more likely to survive here in Pennsylvania. They were sown and are now growing at the greenhouse here at Morris Arboretum; some of them will eventually be planted on the Holly Slope.

## HISTORY AND GENERAL INFORMATION ABOUT HOLLIES

### Ethnobotany

Humans have a very old and intimate relationship with hollies. While we may now primarily think of them as garden plants, mankind’s use of hollies predates horticulture and written records indicate that people have used many species of holly for religious rituals, spiritual practices, medicinal treatments, and practical tools since before the time of the Romans. Hollies likely drew the attention of humans throughout the centuries with their evergreen leaves

and bright red berries that persist through the winter when not many other plants have leaves or fruit (Bailes, 2006).

### ***Symbolism***

Hollies have been important symbols to many cultures and people throughout history. Using evergreen holly branches to decorate homes and places of religious importance for the winter solstice is a traditional practice in much of Europe and Asia. Hollies are still used today in holiday celebrations, but the traditional symbolic significance has been lost and they are viewed by most as merely festive decorations for the season. For example, in pre-Christian times, the green leaves and red berries of the holly that persistent through the cold and dark winter months represented fertility; this same image was later appropriated by the Christians into a representation of Christ's crown of thorns and blood. On another note, for some Native American tribes the holly was a symbol courage and fierceness; warriors in these tribes pinned and painted holly on themselves before going into battle (Bailes, 2006)

### ***Folklore***

Many cultures around the world believed that hollies had magical properties and have superstitions and spells involving them. Native Americans intentionally planted hollies around their permanent settlements in an effort to repel malevolent spirits. In the British Isles, it was seen as bad luck to cut down a holly tree and furthermore, people considered them as a good plant choice for hedgerows as they would prevent witches from gallivanting about the countryside (Bailes, 2006).

### ***Medicine***

Many species of holly have purgative, narcotic, emetic, and stimulant properties that have been used in various rituals and folk medicines by cultures throughout the world. The bark, leaves, and berries have all been used for these purposes from a wide range of holly species, including familiar garden plants *Ilex aquifolium*, *Ilex cornuta*, and *Ilex vomitoria*. Perhaps the most famous and significant of these is the South American species *Ilex paraguayensis*; this tender species of subtropical distribution is the source of the popular drink *yerba mate*, a brewed beverage with gentle stimulating properties made with the fermented leaves.

Other hollies that are used to brew teas include *Ilex latifolia* and *Ilex vomitoria*. The latter of these is a native to the US and is known better by its common name, Yaupon holly. Native Americans in North America used this plant to create cassina or "black drink," an important element in a ritual. Consuming the beverage caused the drinker to sweat and vomit; these effects were considered healthful (Bailes, 2006). Other medicinal uses for holly include the Chinese using *Ilex cornuta* as a cure for kidney disease (all parts of the plant were used in Chinese medicine) and *Ilex verticillata* and *Ilex aquifolium* used for treating fevers (Bailes, 2006)

### ***Tools***

Holly wood is hard and has a close grain; these properties have made it a useful source of wood to create tools. Over the years, practical applications were often merged with magical ones

to make the best use of the holly's physical and metaphysical qualities in tandem. The holly plant itself was considered to have a mystical power over horses and that, combined with the strong yet pliable quality of holly wood, made it an ideal substance for making horsewhips in Britain. Boughs of holly also made a good tool for sweeping chimneys since they served the dual purpose of driving away evil spirits (Bailes, 2006).

### Taxonomy

Hollies are in the Aquifoliaceae family; the name of this family is derived from Aquifolium, a word that means pointed or spiny leaves. *Aquifolium* is the pre-Linnean and classical name for holly (Galle, 1997). The family of Aquifoliaceae once had 4 genera, these were: *Ilex*, *Byronia*, *Nemopanthus*, and *Phelline*. Through the years, taxonomic authorities have revised the family and decided to incorporate *Byronia* into *Ilex* as a subgenus. *Phelline* has been given its own family - Phellinaceae. This left the monotypic genus *Nemopanthus* in the Aquifoliaceae along with *Ilex*. But in 2000, taxonomists deemed that the only species in this genus, *N. mucronatus*, be placed in *Ilex* as well, where it is known by its new name, *Ilex mucronata* (Bailes, 2006).

The taxonomic classification of hollies has changed much over the years; even deciduous hollies used to have their own genus (*Prinos*) until 1890 and, as stated above, hollies themselves were once in a different genus, *Aquifolium*. Linnaeus changed the genus to *Ilex* in reference to the classical name for the holly oak or holm oak, *Quercus ilex*, which somewhat superficially resembles the English holly, *Ilex aquifolium* (Galle, 1997). Interestingly enough, the holm oak was actually named after its resemblance to holly as 'holm' is an old word for holly (Holm Oak).

Most gardeners are only familiar with common garden holly trees and shrubs that come from America, England, China, and Japan, but there are many more from all around the world. *Ilex* is a large, complex, and varied genus, and taxonomic authorities don't agree on the number of species in it. Depending on who you ask, you might hear anywhere from 500 to a number closer to 800, with approximately 30 species being deciduous and the rest evergreen. This difference in opinion is primarily because the tropical range of the genus is not well documented and is generally unexplored. When exploration is undertaken, new species are discovered but often there are also indications that many species already described are the same (Bailes, 2006). Work on *Ilex* taxonomy is underway at both Conservatoire et Jardins Botaniques in Geneva and at the Royal Botanic Gardens at Kew (Galle, 1997).

Species in *Ilex* are present throughout the world in temperate, warm temperate, subtropical, and tropical climates in all continents except Antarctica in both hemispheres. It is also widely recognized in the fossil record, which shows evidence of 250 species that appear to be forerunners of present day *Ilex*. The diversity of the genus can be attributed to a few factors; it is indigenous to many microhabitats, and species can easily fertilize one another when flowering at the same time (Galle, 1997).

There are three major areas of diversity for *Ilex*, the first of which is the Sino-Japanese region which includes Taiwan, Japan, China, Korea, Myanmar, and the Indo-China peninsula. Next is Latin America with a significant representation in South America and Brazil. The third

major area is the Malay Peninsula and archipelagos that consists of Malaya, Indonesia, Borneo, New Guinea, the Philippines, Papua, and the Pacific islands. This wide area of distribution is a good indicator that hollies are plants of ancient origin (Galle, 1997). Additionally, it is interesting to note that *Ilex* is primarily a species of the tropics and subtropics considering that many of our familiar garden hollies are not tropical plants (Bailes, 2006).

### Botanical Description of Holly

#### ***Habit***

How do we know a holly when we see one? There are certain traits that characterize the genus *Ilex*; however there is much variety among the many species classified within it. All hollies are woody plants with many being evergreen trees or multi-stemmed shrubs. Less than 30 holly species are deciduous. Holly trees include *Ilex aquifolium*, *Ilex opaca*, and *Ilex rotunda* and range in height from 50-65 to 100 feet. Hollies with low shrubby habits include *Ilex colombiana* and *Ilex cumulicola* and can range from 3-6 feet. Additionally, some hollies are low growing and others are climbers or epiphytes (Bailes, 2006). The habits of more obscure hollies can be hard to determine since many areas have been disturbed and cut back and the generally slow growing plants have not had an opportunity to reveal their true forms (Galle, 1997).

#### ***Flowers***

Hollies are dioecious and have male and female flowers on different plants. Holly flowers are not what the plants are valued for in the horticultural world, but can be somewhat showy when there are many of them. They are borne in the leaf axils between the leaf and the stem (not on the ends of the branches); have a light fragrance; and can be white, cream, green, pink, or lavender. They usually possess 4 sepals, 4 petals, and 4 stamens though they can have up to 5 to 9 (Brooklyn Botanic Garden, 1993). Evergreen hollies tend to flower earlier than deciduous hollies. Temperate hollies, like the ones native to the Philadelphia region, often flower from early spring to summer. The flowers have a small inflorescence, with the male flowers usually being larger in number than the females (Bailes, 2006).

#### ***Fruit***

The fruit of the holly, though commonly referred to as a berry, is not a berry nor is it a true drupe (Galle, 1997). There is actually no single term for this type of fruit, though it does share features with both a drupe and a berry (Bailes, 2006). Holly fruits are globe or egg shaped and made up of 4 segments; there is one seed within each segment. Most holly fruits are red, but can also be found in white, cream, yellow, orange, or black in the wild and in cultivation. It is important for gardeners to note that only females have berries and they do need a male plant nearby to pollinate their flowers to produce viable fruit. Some hollies bear fruit without a male plant, however the plant often sheds this type of fruit before it is ripe and the seed inside is not viable (Brooklyn Botanic Garden, 1993). Holly fruits are important horticulturally since they persist through the winter unless they are eaten by birds (Bailes, 2006).

#### ***Leaves***

Along with the fruits, the foliage of hollies is valuable to gardeners because the evergreen species offer year-round greenery and deciduous hollies offer fall color (Bailes, 2006). Like other botanical elements of hollies, the leaves can be quite variable from species to species;

however, holly leaves are always simple and never compound or lobed. They are usually alternate but a few species are opposite. The texture can be thick, waxy, and leathery, or quite paper like. The leaf outlines, margins, tips, bases and surfaces can vary widely from species to species; in fact, different leaf forms can be found on the same plant (Brooklyn Botanic Garden, 1993). Spininess is a feature of many hollies in cultivation, but is a minority in the genus as a whole. Leaves become less spiny as the plant matures; spininess on younger plants may be a defense against browsing animals (Bailes, 2006).

### **Hollies in Horticulture**

Hollies also have a long horticulture tradition but are not necessarily one of the most currently sought after plants. Some of their desirable qualities are seemingly working against them. Since they are robust and adaptable and can thrive in urban areas and difficult environments, they are often used for utilitarian plantings and have become overly familiar. Because they are shade tolerant, they can get lost in the understory of larger trees and shrubs and go unnoticed. Yet there are still many reasons to consider a holly for the garden; there are many species of holly and countless cultivars making for a lot of options to choose from. Hollies also make great structural plants and can be a dominant focal point or serve as supporting elements. They are, of course, noted for their winter interest of evergreen foliage and persistent fruit, and as they are traditionally used, great plants for hedges and topiaries. They also work well as screens (Bailes, 2006).

## **HISTORY OF HOLLIES AT MORRIS ARBORETUM**

### Holly Slope

In 1948 when the Arboretum purchased Gates Hall, the four acres of land now known as the “Holly Slope” were also acquired. Many hollies were planted on this location in the years from 1949 to 1953. It was selected as a good site for these plants because it provided southern exposure and well-drained soil. The original planting on the slope was organized according to the hardiness of the species; the curator during this era of the Arboretum chose to plant many plants and cultivars of our native *Ilex opaca* near the top which was more exposed, and planted the more tender species like *Ilex aquifolium* and *Ilex* × *altaclerensis* in the lower part of the slope where they would receive more shade and protection from the elements (Aiello & Goff, 2005).

### Collection through the Years

The Morris Arboretum has been an official holly arboretum since 1948. While some hollies do remain from the time when John and Lydia Morris lived here, the collection has grown, and more plants have been added through the years both on the Holly Slope and throughout the Arboretum. The Arboretum can now boast 174 taxa of holly; with many plants that are over half a century old, it is one of the largest collections in the Delaware Valley. Unfortunately, the collection has suffered some neglect at times over the years and there has been an ongoing effort by Arboretum staff to maintain and renovate it at various points in time. Parts of the collection were reviewed and verified in 1979 and again in 1987, at which time

records and maps of the hollies were updated. Many new hollies were planted in 1980s and 1990s, including a significant planting of *Ilex glabra* 'Densa' for a hedge dividing the four quadrants in the Rose Garden (Aiello & Goff, 2005).

### Recent and Current Work on the Holly Slope

Notably in recent years, the Arboretum's current curator, Tony Aiello, has had an ongoing long-term project of renovating the holly collection by verifying, pruning, planting, and removing plants since he came into the position in 1999. The goals of this project are "to improve health and beauty by removing unidentified and unhealthy specimens, grow wild collected species and propagate superior varieties from other collections, add diversity to the collection, share hollies with other gardens and individuals and to demonstrate a wider range of hollies to the public." The plants in the collection were evaluated for recommendations of propagating, pruning, and removing in 2002. Since 2001, there have been ongoing efforts to expand the holly collection through visiting other collections for hollies to propagate and to eventually plant out (Aiello & Goff, 2005).

## **PROJECT**

### Assessing the Hollies and Correspondence with other Holly Collections

The first goal of my project was to assess the plants located in a particular section of the Holly Slope. Using the Arboretum's plant locator computer program, you can see that the map of the Arboretum is divided into a grid with numbers on the horizontal axis and letters on the vertical axis. The area I worked with is located within grids K20, K21, L20, and L21. The two criteria that I was concerned with were whether any of the plants located in this area were special, rare, or unique and whether any of them held some significance to the Arboretum.

In order to determine the first of these two things, I had to contact a number of major holly collections. I contacted staff at nine gardens and arboreta, many of which are somewhat nearby. In my initial correspondence, I emailed an appropriate staff member and explained my project and its objectives. I also asked two questions: if they could send me a list of the hollies in their collections, and if they would be interested in adding any of the hollies we propagate to their collections. Most places responded right away and provided me with a list of their hollies, and all but a few exceptions of these institutions said they would be interested in seeing our list of plants in order to expand their own holly collections. This is a particularly exciting aspect of the project for me, as it is quite thrilling to know that many other notable gardens will likely be adding plants that I personally propagated to their collections.

The next step was to take all of the lists I received and compile them into one master list that I organized alphabetically. I compared the plants on this master list to a list of the plants located in the specified grids on the holly slope. This comparison yielded yet another list of 18 different species and cultivars that none of the other gardens I contacted had in their collections. These were the plants I propagated. Later, we generated a second list of a select six plants that

were present at only one other place and propagated those as well. Among the plants on the lists were several old *Ilex opaca* cultivars from the late 1940's and early 1950's that seem to have been lost from the nursery trade. Included amongst these were *Ilex opaca* 'Formal,' which originated at the Morris Arboretum and *Ilex opaca* 'Morris Arboretum,' a cultivar with vivid yellow orange fruits (Galle, 1997).

## Holly Propagation

### **Research**

Hollies can be propagated by seed, severing stolons, layering, grafting, tissue culture, and rooting stem cuttings, which is the most commonly used method and also the one that I used. In order to produce new individual plants from stem cuttings, they must be rooted. This process involves visiting the plant to be propagated and removing a terminal stem consisting of current season's growth. It is best to get a cutting length of 4-6 inches to ensure sufficient length for rooting; often a stem over this length is taken from the plant and cut down to size later. Some important things to keep in mind when taking cuttings is to choose the right time of year to take cuttings for a particular species, avoid taking cuttings on a day where the temperature is below freezing, and to carefully label everything. The rooting process is done by cutting the shoot down to the appropriate size and removing most of the leaves; this allows the cutting to put its energy towards root production while it is still able to perform photosynthesis. The next step is to wound the base of the stem to expose the cambium layer to the rooting hormone. Then, the cutting is treated with a root promoting chemical. Finally, the cuttings are stuck in a damp medium and placed in a warm, humid, well-lit environment (Brooklyn Botanic Garden, 1993).

### **Methods**

When I was ready to take cuttings from the plants on my propagation list, I did some preparation in advance. First I reviewed some books and the propagation files in the greenhouse to find out the appropriate time range for taking holly cuttings; this turned out to be roughly October to March. Also using the greenhouse propagation files, and in consultation with the Arboretum's propagator, Shelley Dillard, I decided to use media made up of 70% perlite to 30% peat to stick the cuttings into. I mixed the media and prepared the pots in advance so they would be ready to go once I arrived back with the cuttings.

I took cuttings of most of the plants in late December and a few more in late January. The second round of cuttings was done in late February. Each cutting was trimmed to 4-6 inches in length, given a double wound at the base of the stem, and treated with a rooting hormone. I used IBA powder and K-IBA liquid both in a concentration of 8,000 parts per million. IBA (indole-3-butyric acid) is a synthetic form of the plant hormone auxin. The liquid K-IBA contains potassium, which is thought to help transport the hormone through the cell membrane. The purpose of the two treatments was to see if the cuttings would root better with liquid or powder rooting hormone, but there was no significant difference. Then they were stuck in the media and placed in the warm greenhouse propagation room. I aimed for 20 cuttings from each plant.

### **Results, Discussion, and Conclusion**

The results for my cutting propagation have been very good. Cuttings from all 18 plants on my initial propagation list have rooted and many have new growth, some of which is very

vigorous. It is still too early to tell the results for the plants I propagated in February. We began potting up the cuttings into individual pots in early April 2014.

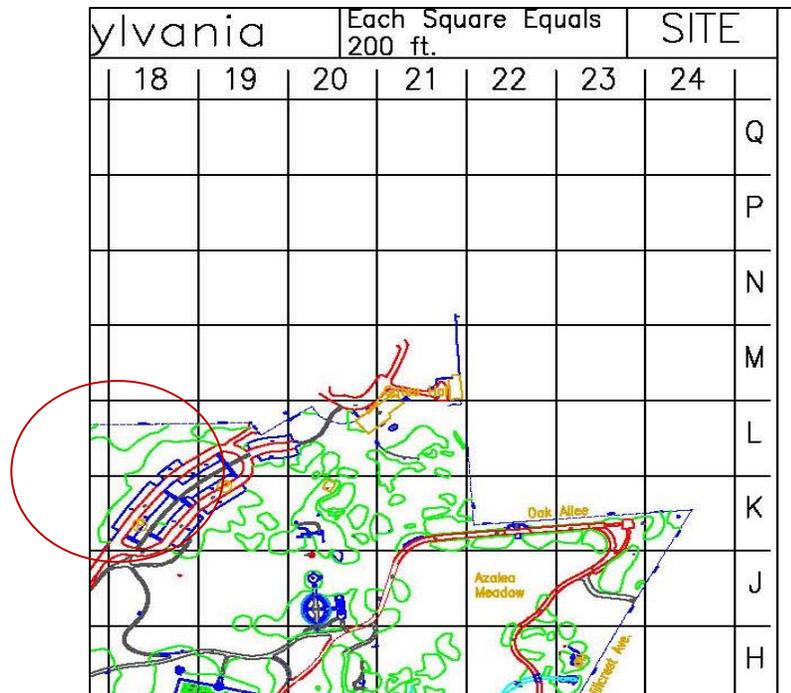
Some issues that I faced during the propagation process included finding little new growth on some plants when taking cuttings, cuttings that died, and pests. *Ilex opaca* 'Formal', one of the plants I was most hoping to successfully propagate because of its significance to the Arboretum had barely any current season's growth. I did manage to find about 10 cuttings that were at least a few inches tall, though not nearly close to 4-6. Fortunately, despite being short, almost all the cuttings appear to be rooted. Inexplicably dead cuttings are another concern, particularly since many of them actually had good root growth. It is hard to tell why they died, but in some cases I suspect the dripping water from the fogger in the propagation greenhouse was the cause. Finally, many of the cuttings became infested with cottony camellia scale and some had white fly egg cases. It is likely that these pests existed on the plant outside and came in with the cuttings. This is especially likely with the white fly egg cases since there was no evidence of white fly in the greenhouse. Furthermore, when viewed under the microscope, they all appeared to have exit holes. To treat these issues, the cuttings were sprayed with oil.

In conclusion, to finish up my contribution to the Holly Slope renovation, I plan to continue collecting data on all the plants I propagated and continue potting up the rooted cuttings. Also, I intend to contact the holly collections with which I corresponded with a final list of the hollies that we are offering to share as a result of this project. In the future, the plants on the holly slope will be assessed on a variety of criteria to determine if they should remain there or be removed to create more space. The live oaks growing in the greenhouse will be tested for hardiness over the next few years and those that survive overwintering will be candidates for planting out on the Holly Slope.

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[http://apps.kew.org/trees/?page\\_id=91](http://apps.kew.org/trees/?page_id=91)





**APPENDIX B** – List of Gardens and Arboreta Contacted

- New York Botanical Garden
- Tyler Arboretum
- Scott Arboretum
- U.S. National Arboretum
- Dawes Arboretum
- Longwood Gardens
- Bernheim Arboretum and Research Forest
- Rutgers Gardens
- Brooklyn Botanic Garden

**APPENDIX C - Hollies Propagated**

Acession #	Grid #	Name	Common name			
49-377*A	K21	Ilex aquifolium 'Integrifolia'	Entire-leaved English holly			
51-634*A	K20	Ilex aquifolium 'Wheeler No. 4'	Wheeler No. 4 English holly			
48-851*C	K20	Ilex aquifolium 'Yonkers'	Yonkers English holly			
2007-250*A	K21	Ilex 'Conive'	FESTIVE holly			
64-754*A	K21	Ilex crenata 'Repandens'	Spreading Japanese holly			
49-831*A	K20	Ilex cumulicola 'Fort McCoy'	Fort McCoy Hummock holly			
49-845*A	L20	Ilex opaca 'Beulah'	Beulah American holly			
49-844*A	L20	Ilex opaca 'Fay'	Fay American holly			
50-013*A	K21	Ilex opaca 'Formal'	Formal American holly			
50-008*A	L21	Ilex opaca 'King Christmas'	King Christmas American holly			
49-849*A	K20	Ilex opaca 'La Bar No. 1'	La Bar No. 1 American holly			
48-871*B	K20	Ilex opaca 'Laura Thomas'	Laura Thomas American holly			
51-462*A	K20	Ilex opaca 'Lewis Swartz'	Lewis Swartz American holly			
51-463*A	K21	Ilex opaca 'Mallory'	Mallory American holly			
49-799*A	L21	Ilex opaca 'Perrine'	Perrine American holly			
49-799*C	L21	Ilex opaca 'Perrine'	Perrine American holly			
49-443*B	K20	Ilex opaca 'Sara Higgins'	Sara Higgins American holly			
48-878*B	L21	Ilex opaca 'Wheeler No. F-1'	Wheeler No. F-1 American holly			
49-379*B	K20	Ilex perado ssp. platyphylla	Canary Islands holly			