

Toccoa zoysiagrass

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ABSTRACT

'Toccoa' zoysiagrass, also known as 'Toccoa Green' and previously as 'Pristine' and 'Pristine Flora,' was developed by the Florida Agricultural Experiment Station at the Everglades Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, FL, and initially approved for release in 2005. This zoysiagrass variety originated as an open-pollinated progeny from 'Emerald' and tested in Florida under experimental designation BA-305. 'Toccoa' was selected for improved agronomic and horticultural traits, including reduced production of seed heads, finer leaf texture, darker leaf color, and a faster rate of ground coverage and crop establishment in southern Florida. In comparison to the standard variety Emerald, 'Toccoa' exhibited a 46% average annual reduction in seed-head production and generally produced seed heads with an attenuated morphology. It also produced darker green leaves that were 21% shorter and 19% narrower than Emerald, which visually conferred upon 'Toccoa' a more refined canopy structure and texture. In addition, ground coverage and crop establishment was significantly faster for 'Toccoa' at two of the three test sites. 'Toccoa' is primarily intended for use in the specialty markets of Florida, the Caribbean, and Southeast Asia for zoysiagrass.

Toccoa™ 'BA-305' FFSP Overview

- **Natural, dark green color**
- **Fine textured yet dense**
- **Fast rate of growth**
- **Quick recovery from scalping**
- **Fewer seed heads than other varieties**

Toccoa™ brand Zoysia matrella cultivar 'BA-305' was released by the University of Florida. It is recommended for use in high-maintenance situations, including golf courses and high-end home lawns. This variety is fine textured, extremely dense, and has a dark green color. Toccoa™ does not produce seed heads as prolifically as other fine-textured cultivars, such as 'Emerald' or 'Diamond'. Toccoa™ is similar in appearance and maintenance to 'Diamond'; however, it has a much faster rate of growth and recovers more quickly from scalp damage.

Toccoa™ was developed by the Florida Agricultural Experiment Station at the Everglades Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, FL. It was first identified and selected in Palm Beach County, FL, and was tested across the state of Florida under the experimental designation of 'BA-305.' The purpose of this breeding program was to select and develop an alternative to the standard variety Emerald and to potentially enlarge the diversity of narrow-leaved zoysiagrass varieties grown in the southeastern United States.

'BA-305' was selected for improved agronomic and horticultural traits, including reduced production of seed heads, a finer leaf texture as defined by shorter and narrower leaves, a darker leaf color, and a faster rate of establishment and ground coverage in southern Florida, where temperatures are notably warmer than in most of the United States. It was initially approved for release in 2005.

Characteristics and Description

The distinctiveness of 'BA-305' from 'Emerald,' its putative progenitor, is based on four sets of traits including: 1) floral morphology; 2) stem and leaf morphology; 3) color and pigmentation; and 4) rate of growth and cover. Measures of disease and insect resistance yielded no significant statistical differences.

This new variety of Zoysiagrass is a perennial plant propagated asexually from either rhizomes, stolons, sprigs, or plugs. It is best adapted to the subtropical climates of Florida. 'BA-305' was tested and described under field conditions at four research sites in Florida, including Arcadia, Belle Glade, Gainesville, and Milton.

In Florida, "BA-305" was compared to the standard variety Emerald for eight inflorescence traits and the two genotypes were significantly different for seven of the eight traits. In each case 'BA-305' had a smaller and more refined morphology. 'BA-305' had a significantly shorter overall shoot length, seed head length, peduncle length, and the exposed peduncle length, although shorter, was not statistically significant. Seed head width and the average number of seed per raceme (Seed Count/Seed Head) were also significantly smaller. Additionally, 'Emerald' had a higher seed density on the raceme than 'BA-305," but this trait was not visually discernible. Glume length and glume width were also smaller. Essentially, 'BA-305' had smaller and fewer seeds distributed at a lower density on shorter seed heads with smaller peduncles.

Color

Leaf color and stolon and rhizome pigment varied between 'BA-305' and Emerald, as determined by a comparison of fresh leaf and stolon tissue samples to color panels in the Munsell Color Chart (Munsell Color, 1977). The adaxial surface of the leaves of 'BA-305' ranged from 7.5GY (4/6) to 7.5GY (5/6) in color. Emerald produced leaves of less-intense green color and ranged from 5GY (4/6) to 7.5GY (4/6).

On rhizomes exposed to sunlight, 'BA-305' produced a pigment that ranged up to 5RP (3/2), while Emerald produced a lighter pigment that measured 5RP (4/2). Although these color differences were not separated statistically, they were visibly discernable.

Seed Heads

Seed-head size, frequency, and volume are major considerations in the specialty market for zoysiagrass. 'BA-305' seed heads were significantly shorter and produced fewer seeds than Emerald. 'BA-305' carried an average of 11 seeds on 9.65 ± 0.40 mm long seed heads that were 1.22 ± 0.06 mm wide. Emerald also had a higher seed density on the raceme compared with 'BA-305' (0.880 seed mm^{-1} vs. 0.727 seed mm^{-1}), but this trait was not visibly discernable. In general, 'BA-305' produced seed heads that were nearly 27% shorter and carried one-third fewer seeds than Emerald. Additionally, 'BA-305' produced seeds that were 2.43 ± 0.08 mm in length and were significantly shorter than Emerald seeds, which measured 2.67 ± 0.06 mm. Seed of 'BA-305' and Emerald averaged 0.81 mm and 0.89 mm in width, respectively.

Over 12-mo establishment experiments, 'BA-305' produced 46% fewer seed heads than Emerald. On an individual month basis, 'BA-305' produced an average of 3.45 ± 0.84 seed heads dm^{-2} , which was significantly less than the 6.40 ± 1.73 seed heads dm^{-2} produced by Emerald. 'BA-305' produced seed head averages that ranged from 0 to 7.97 seed heads dm^{-2} per month, while Emerald ranged from 0 to 16.0 seed heads dm^{-2} . Emerald had a peak in seed-head production during February, with the heaviest flush from December through March, and was off-set from 'BA-305', which had a bimodal flush of seed heads produced from August through November and again in March. Emerald produced more seed heads than 'BA-305' in 7 of 12 months, with the magnitude of the differences varying among months (Fig. 1).

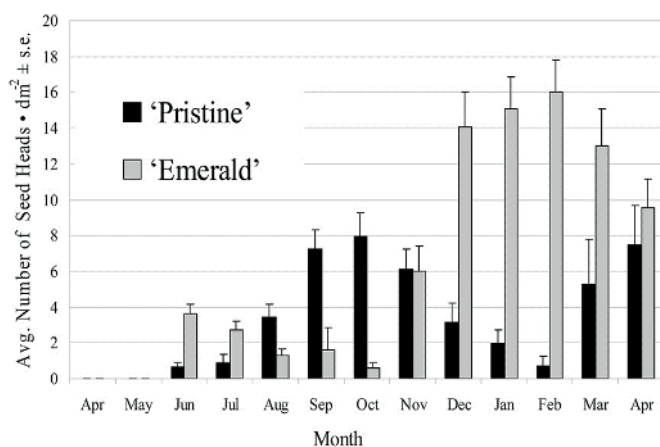


Figure 1. Comparison of the average seed head production between zoysiagrass cultivars BA-305 and Emerald measured on a monthly basis in Palm Beach County, FL.

This result was repeated when measured on a subjective rating scale at the Charlotte County test site; Emerald again produced significantly more seed heads than 'BA-305' in 4 of the 12 months. Similar results were obtained at the Alachua County test site, but no significant differences occurred at the northern test site in Santa Rosa County. As with a robust inflorescence, prolific production of seed heads also detracts from turf quality and appearance but further exacerbates the difficulty of managing crop purity in a clonally propagated perennial variety. In general, seed-head production is an undesirable trait in this segment of the turf industry.

Leaf Characteristics

Leaf texture was assessed by measurements of leaf morphology, and both varieties were again dissimilar (Tables 1-3). 'BA-305' exhibited shorter and narrower flag leaves as well as shorter leaf sheaths than Emerald. Stolon and leaf morphology of the vegetative tissue was measured on fully expanded leaves at the fifth node below the meristem. The leaf length of 'BA-305' averaged 48.1 ± 2.66 mm compared with 60.8 ± 2.16 mm for Emerald. Likewise, leaf width for 'BA-305' was 1.59 ± 0.07 mm versus 1.96 ± 0.08 mm for Emerald. (Table 1)

The overall inflorescence length as measured from the apex of the seed head to the uppermost or flag leaf node averaged 35.8 ± 1.17 mm for Emerald compared with 26.1 ± 0.82 mm for 'BA-305'. Internode length and width for 'BA-305' averaged 20.92 ± 0.45 mm and 1.35 ± 0.06 mm, respectively. Emerald produced internodes that averaged 11.37 ± 0.58 mm in length and 2.07 ± 0.08 mm in width. 'BA-305' produced internodes that were 84% longer than Emerald; however, no meaningful difference existed between internode widths (Table 2).

In general, 'BA-305' produced leaves that were 21% shorter and 19% narrower than Emerald. The overall peduncle length, as measured from the flag leaf node to the base of the seed head, and the exposed portion of the peduncle not enveloped by the sheath of the flag leaf were both significantly shorter on 'BA-305'. Peduncle width did not differ between varieties. (Table 3)

TABLE 1

| Comparison of floral traits between 'Emerald' and 'BA-305'. | | | | | |
|--|-----------|------------|----------|------------|---------------------|
| Trait (in mm) | 'Emerald' | | 'BA-305' | | LSD $\alpha = 0.05$ |
| | Mean | \pm s.e. | Mean | \pm s.e. | |
| Overall Shoot length ^z | 35.80 | 1.17 | 26.05 | 0.82 | 5.565 |
| Seed Head Length ^y | 11.76 | 0.55 | 9.65 | 0.40 | 1.908 |
| Seed Head Width ^x | 1.53 | 0.07 | 1.21 | 0.06 | 0.187 |
| Seed Count/Seed Head | 16.10 | 0.87 | 10.90 | 0.48 | 3.10 |
| Exposed Peduncle | 12.40 | 0.91 | 7.95 | 0.80 | 4.95 (ns) |
| Peduncle Length ^u | 23.35 | 1.36 | 15.18 | 0.51 | 5.33 |
| Glume Length ^t | 2.66 | 0.06 | 2.43 | 0.08 | 0.19 |
| Glume Width ^s | 0.89 | 0.02 | 0.81 | 0.04 | 0.06 |

^zOverall shoot length is a measure of the total inflorescence length from the apex of the seed head to the first node on the peduncle subtending the raceme

^ySeed Head Length is measured from the apex of the seed head to the top of the peduncle on the base of the raceme.

^xSeed Head Width is measured at the broadest part of the seed head.

^wSeed Count/Seed Head is the average number of seeds per head or raceme.

^vExposed Peduncle Length is the average length of the peduncle not covered by the flag leaf sheath.

^uPeduncle Length is the average pinnacle length measured from the base of the seedhead to the top of the node.

^tGlume Length is a measure of the average glume length on the seed located at the mid point along the seedhead.

^sGlume Width is measured at the widest part of the glume.

TABLE 2

| Comparison of flag leaf traits between 'BA-305' and 'Emerald' | | | | | |
|--|-----------|------------|----------|------------|------------------------|
| Trait (in mm) | 'Emerald' | | 'BA-305' | | LSD $\alpha \leq 0.05$ |
| | Mean | \pm s.e. | Mean | \pm s.e. | |
| Flag Leaf Length ^z | 9.20 | 0.99 | 4.65 | 0.44 | 1.97 |
| Flag Leaf Width ^y | 0.79 | 0.25 | 0.81 | 0.03 | 0.08 (ns) |
| Flag Leaf Sheath ^x | 11.45 | 0.77 | 8.50 | 0.65 | 2.35 |

^zFlag Leaf Length is measured from the apex of the leaf to the top of the leaf sheath.
^yFlag Length Width is measured at the widest part of the flag leaf.
^xFlag Leaf Sheath is measured from the top node to the base of the flag leaf.

TABLE 3

| Comparison of leaf morphology between 'BA-305' and 'Emerald'. | | | | | |
|--|-----------|------------|----------|------------|------------------------|
| Trait (in mm) | 'Emerald' | | 'BA-305' | | LSD $\alpha \leq 0.05$ |
| | Mean | \pm s.e. | Mean | \pm s.e. | |
| Leaf Length | 60.80 | 2.16 | 68.07 | 2.66 | 8.34 |
| Leaf Width ^z | 1.96 | 0.08 | 1.59 | 0.07 | 0.25 |
| Internode Length | 11.37 | 0.58 | 20.92 | 0.45 | 2.29 |
| Internode Width ^y | 1.33 | 0.06 | 1.35 | 0.06 | 0.18 (ns) |

^zLeaf Width is measured at the widest part of the leaf.

^yInternode Width is measured at the widest part of the internode.

The aggregate measurement of these traits confirmed the visual assessment that Emerald produced a more robust and coarse inflorescence, which is an aesthetically undesirable trait that detracts from turf quality. The total number of seed heads produced in the canopy also varied by season and variety, as analyzed previously (see Fig. 1)

Growth Performance

These varieties also differed for their rate of ground coverage and crop establishment. From the initiation of the growth rate experiment, 'BA-305' covered the plots faster and had significantly more cover in each month of the year.

In Palm Beach County, 'BA-305' attained 50% coverage in 5.2 months, while it took 'Emerald' 8.0 months; 100% coverage was attained in 10.5 months for 'BA-305' and 'Emerald' required over 13 months, only covering 87.5% of the prescribed area within the 12-mo. period (Fig. 2). The number of stolons and the stolon length were also significantly more and longer for 'BA-305' compared to 'Emerald'.

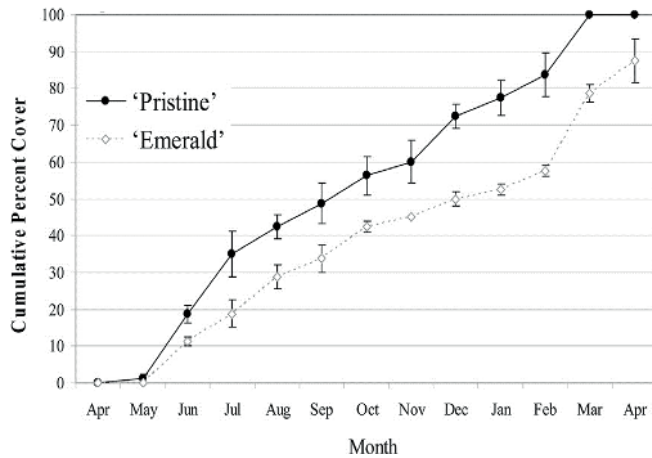


Figure 2. Comparison of cumulative average coverage measured on a monthly basis between zoysiagrass cultivars Pristine and Emerald in Palm Beach County, FL.

This result from Palm Beach County was supported and repeated in Charlotte County, where 'BA-305' fully covered the plots in an average in 7.0 mo, and attained 50% plot coverage in about 5.3 mo. In contrast, Emerald took 10.0 mo to fully cover the plots and 6.7 mo to attain 50% coverage. At the northern test site in Santa Rosa County on the Florida panhandle, there was essentially no difference in these two varieties for the rate of crop establishment.

This significantly faster rate of coverage gave 'BA-305' an important agronomic advantage relative to harvest intervals and crop maintenance. The stronger growth rates and average cover of 'BA-305' compared with Emerald was reconfirmed by monthly measurements of average cover and number/length of stolons/rhizomes. 'BA-305' measured higher in every category each month (Table 5).

TABLE 5

Comparison of average cover, stolon/rhizome number,
and stolon/rhizome length between 'BA-305' and
'Emerald' measured on a monthly basis.

| | MONTH | | | |
|----------------------------------|--------------|--------------|--------------|--------------|
| | APRIL | MAY | JUNE | JULY |
| <u>Covered^z</u> | | | | |
| 'BA-305' | 0 | 1.25 ± 1.25 | 10.75 ± 2.39 | 35.00 ± 6.12 |
| 'Emerald' | 0 | 11.25 ± 1.25 | 18.75 ± 3.75 | |
| <u>Stolon Number^x</u> | | | | |
| 'BA-305' | 0 | 0 | 2.25 ± 1.03 | 7.75 ± 0.63 |
| 'Emerald' | 0 | 0 | 0.25 ± 0.25 | 5.25 ± 1.93 |
| <u>Stolon Length^z</u> | | | | |
| 'BA-305' | 0 | 0 | 1.75 ± 0.63 | 3.25 ± 0.75 |
| 'Emerald' | 0 | 0 | 0.25 ± 0.25 | 1.75 ± 0.48 |
| | AUGUST | SEPTEMBER | OCTOBER | |
| <u>Covered^z</u> | | | | |
| 'BA-305' | 42.50 ± 3.23 | 48.75 ± 5.54 | 56.25 ± 5.15 | |
| 'Emerald' | 28.75 ± 3.15 | 33.75 ± 3.75 | 42.50 ± 1.44 | |
| | MONTH | | | |
| <u>Stolon Number^x</u> | | | | |
| 'BA-305' | 11.50 ± 0.87 | 11.50 ± 0.87 | 11.25 ± 0.63 | |
| 'Emerald' | 5.25 ± 1.60 | 5.25 ± 1.60 | 7.50 ± 0.87 | |
| <u>Stolon Length^z</u> | | | | |
| 'BA-305' | 3.50 ± 0.65 | 4.75 ± 0.85 | 6.25 ± 0.63 | |
| 'Emerald' | 2.25 ± 0.48 | 3.50 ± 1.19 | 4.00 ± 0.0 | |
| | NOVEMBER | DECEMBER | JANUARY | |
| <u>Covered^z</u> | | | | |
| 'BA-305' | 60.00 ± 5.77 | 72.50 ± 3.23 | 77.50 ± 4.79 | |
| 'Emerald' | 45.0 ± 0.0 | 50.0 ± 7.04 | 52.5 ± 1.44 | |
| <u>Stolon Length^z</u> | | | | |
| 'BA-305' | 6.00 ± 0.71 | — | — | |
| 'Emerald' | 4.00 ± 0.0 | — | — | |
| <u>Stolon Number^x</u> | | | | |
| 'BA-305' | 11.25 ± 0.83 | — | — | |
| 'Emerald' | 7.50 ± 0.87 | — | — | |
| | FEBRUARY | MARCH | APRIL | |
| <u>Covered^z</u> | | | | |
| 'BA-305' | 83.75 ± 5.91 | 100.00 ± 0 | 100.00 ± 0 | |
| 'Emerald' | 57.55 ± 1.44 | 78.75 ± 2.39 | 87.5 ± 6.02 | |
| <u>Stolon Number^x</u> | | | | |
| 'BA-305' | — | — | — | |
| 'Emerald' | — | — | — | |
| <u>Stolon Length^z</u> | | | | |
| 'BA-305' | — | — | — | |
| 'Emerald' | — | — | — | |

^zCover is measured as the cumulative percentage of cover over a prescribed plot area.

^xStolon Number is a count of stolon/rhizomes radiating from a central plug over a prescribed plot area.

^zStolon Length is a number of the average length in cm of the stolons/rhizomes.

A narrower and shorter leaf morphology combined with a darker green leaf color produced a canopy with better turf quality and appearance, along with a finer leaf texture. The longer internodes of 'BA-305' did not affect turf quality but may have contributed to the rate of crop establishment.

A vegetatively propagated turf variety that is established and closes canopy more rapidly is typically harvested earlier and generally requires fewer inputs. These important agronomic and economic advantages are particularly useful for growers in the southern production regions of the state, where land is more expensive, water is more restricted, and operating costs are higher.

In summary, 'BA-305' differed from Emerald for four groups of traits. Horticultural traits such as leaf texture and color significantly enhanced turf quality and over-all appearance. The production of fewer and smaller seed heads distributed at a lower density in the canopy imparted the appearance of a more refined floral morphology and provides both agronomic and horticultural benefits.

Compared with Emerald, 'BA-305' also exhibited a significantly faster rate of crop establishment and coverage in the southern production regions. This imparts important agronomic and economic advantages relative to harvest intervals, crop maintenance, and production costs

Cross-Species Comparison

Given the comparatively strong performance of 'BA-305' in the warmer and wetter climates of central and southern Florida, the University of Florida and Florida Foundation Seed Producers (FFSP) did not submit 'BA-305' to the National Turfgrass Evaluation Program (NTEP) of the U.S. Department of Agriculture. NTEP trials are generally carried out in colder and far drier locations which were not expected to be relevant for 'BA-305.'

As a comparison, the standard varieties Emerald and Meyer, as well as the newer variety Zeon, were tested from a 1996 planting in Carbondale, Illinois, as referenced in the application for patent on Zeon,

"a progeny of a zoysiagrass plant in a collection of plants from Kobe, Japan made by Jack Murray (deceased). From these progenies, as seeds, were grown a collection of plants from which a single plant was later cloned into sod and called "Zeon."

According to the Zeon patent application, in Carbondale,

"Zeon ranked higher in turf quality than Emerald (unpatented) or Meyer (unpatented), and, as seen in Table 1, has texture similar to that of Emerald."

TABLE 1

| Traits of Selected Zoysiagrass Cultivars — Planted 1996, data 1997 and 2001, Carbondale, Illinois. | | | | |
|---|--------------------------|-------------------------|-----------------------------|-----------------------|
| | Stolon Length cm/m | Sod Spread cm | Stolon Freq. 9 = most | Texture 9 = finest |
| 'Chinese Common' | 127.1 | 2.7 | 7 | 2.0 |
| 'El Toro' | 311.6 | 4.9 | 9 | 4.3 |
| 'JaMur' | 426.5 | 4.7 | 9 | 5.7 |
| 'Meyer' | 48.6 | 2.2 | 5 | 7.3 |
| 'Emerald' | 91.2 | 1.3 | 5 | 8.3 |
| 'Zeon' | 372.0 | 1.2 | 5 | 9.0 |
| LSD 0.05 | 52.6 | 0.7 | | |
| | Thatch 9 = least | Posture 9 = vertical | Avg. Stolon Lgth cm | |
| 'Chinese Common' | 2 | 6 | 14.66 | |
| 'El Toro' | 4 | 8 | 17.38 | |
| 'JaMur' | 9 | 4 | 17.42 | |
| 'Meyer' | 3 | 9 | 5.55 | |
| 'Emerald' | 1 | 7 | 6.56 | |
| 'Zeon' | 8 | 8 | 11.60 | |
| LSD 0.05 | | | 4.92 | |

from the same patent application:

As shown in Table 2, the shoot blade length and sheath lengths of 'Zeon' were shorter than that of 'Meyer', but similar to that of 'Emerald'. The stolon blade width of 'Zeon' was greater than that of 'Emerald', but less than that of 'Meyer'. Its stolon sheath length was greater than those of 'Emerald' and 'Meyer' but shorter than those of 'El Toro'(U.S. Plant Pat. No. 5,845) and 'Chinese Common' (unpatented). The shoot blade width of 'Zeon' was thinner than for all the other varieties shown.

TABLE 2

| Traits of Selected Zoysiagrass Cultivars — Planted 1996, data 1997 and 2001, Carbondale, Illinois. | | | | | | |
|---|--------------------------------|---------------------------------|-------------------------------|--------------------------------|---------------------------------|----------------------------------|
| | Shoot Blade Length cm | Stolon Blade Length cm | Shoot Blade Width mm | Stolon Blade Width mm | Shoot Sheath Length cm | Stolon Sheath Length cm |
| 'Chinese Common' | 9.00 | 2.69 | 3.83 | 4.1 | 3.65 | 1.08 |
| 'El Toro' | 7.82 | 2.85 | 3.33 | 3.9 | 3.70 | 1.08 |
| 'JaMur' | 7.03 | 2.43 | 4.12 | 4.0 | 2.75 | 1.00 |
| 'Meyer' | 8.58 | 1.84 | 3.00 | 2.9 | 3.15 | 0.55 |
| 'Emerald' | 6.00 | 0.48 | 3.17 | 1.2 | 2.17 | 0.62 |
| 'Zeon' | 6.03 | 1.60 | 2.10 | 1.9 | 2.57 | 0.80 |
| LSD 0.05 | 0.94 | 0.31 | 0.50 | 0.4 | 0.49 | 0.16 |

TABLE 3

| Traits of Selected Zoysiagrass Cultivars — Planted 1996, data 1997 and 2001, Carbondale, Illinois. | | | | | | |
|---|---------------------------|-------------------------------|--------------------|--------------------------------|-------------------------------|--------------------------------|
| | Internode Length cm | Inter- node Width mm | Internode Color | Nodes to First Branch | Blade Hair Length mm | Ligule Hair Length mm |
| 'Chinese Common' | 4.65 | 2.00 | Dark Red | 4.00 | 2.8 | 2.00 |
| 'El Toro' | 4.13 | 1.00 | Dark Red | 1.67 | 1.2 | 2.17 |
| 'JaMur' | 4.78 | 1.95 | Dark Red | 2.00 | 1.0 | 1.95 |
| 'Meyer' | 1.82 | 1.88 | Red | 2.00 | 1.3 | 1.63 |
| 'Emerald' | 2.08 | 1.20 | Dark Red | 3.33 | 1.2 | 0.00 |
| 'Zeon' | 2.15 | 1.30 | Red | 1.50 | 1.0 | 2.50 |
| LSD 0.05 | 0.50 | 0.27 | | 0.61 | 0.3 | 0.30 |

TABLE 4

| Traits of Selected Zoysiagrass Cultivars — Planted 1996, data 1997 and 2001, Carbondale, Illinois. | | | | | | |
|---|--------------------------|-------------------------|---------------------------------|------------|-------------------------------------|----------------------|
| | Blade Hair Density | Stolons per Meter | Leaf Surface with Rust | Hairs % | Perimeter Stolon Length cm | Branches per Node |
| 'Chinese Common' | 3.3 | 9.1 | 1.7 | 96 | 54.37 | 0.90 |
| 'El Toro' | 2.0 | 19.0 | 2.0 | 78 | 68.67 | 1.28 |
| 'JaMur' | 1.3 | 24.1 | 1.0 | 62 | 63.88 | 1.11 |
| 'Meyer' | 2.0 | 7.5 | 2.0 | 58 | 28.57 | 2.60 |
| 'Emerald' | 2.0 | 14.1 | 1.0 | 68 | 32.25 | 1.40 |
| 'Zeon' | 2.3 | 24.5 | 1.0 | 100 | 34.55 | 1.01 |
| LSD 0.05 | 0.7 | 5.5 | 0.9 | 29 | 9.44 | 1.04 |

Table 5 is listed as showing additional comparative data:

TABLE 5

Qualities of Turf in the National Zoysiagrass Cultivar Evaluation Trial,
Planted 1996, Data 1997, Carbondale Illinois
Ratings- 9 = Darkest, Finest, Greatest, or Best

| | Turf Quality | | | | | | |
|----------------|--------------|-------------|------|------------|-----|-----|-----|
| | Color | Spg Grnp | Txtr | Jvn Vgr | May | Jun | Jul |
| HT-210 | 8.7 | 1.0 | 9.0 | 4.3 | 9.0 | 9.0 | 9.0 |
| DALZ 9601 | 8.0 | 7.7 | 9.0 | 4.0 | 8.7 | 8.7 | 8.7 |
| Zeon | 8.0 | 4.0 | 9.0 | 3.0 | 8.0 | 8.0 | 8.0 |
| FR | 8.3 | 1.0 | 9.0 | 1.0 | 7.7 | 7.7 | 7.7 |
| Emerald | 8.0 | 6.0 | 8.3 | 5.7 | 8.0 | 8.3 | 8.3 |
| DeAnza | 7.0 | 1.0 | 7.7 | 5.3 | 7.7 | 8.0 | 8.0 |
| Meyer | 8.7 | 9.0 | 7.3 | 7.7 | 7.7 | 8.0 | 8.3 |
| J-14 | 7.7 | 9.0 | 6.3 | 7.3 | 7.7 | 8.0 | 8.7 |
| Victoria | 8.3 | 2.3 | 7.0 | 5.3 | 6.7 | 7.0 | 7.0 |
| OH-1 | 7.0 | 3.7 | 9.0 | 3.7 | 5.3 | 6.0 | 6.0 |
| JaMur | 6.3 | 1.7 | 5.7 | 3.7 | 6.0 | 7.3 | 8.0 |
| 2040 | 8.3 | 1.0 | 5.7 | 1.0 | 6.0 | 6.0 | 6.0 |
| El Toro | 5.3 | 2.3 | 4.3 | 7.7 | 6.0 | 7.0 | 7.7 |
| J-37 | 7.7 | 8.3 | 5.0 | 8.3 | 5.3 | 6.0 | 6.0 |
| Zenith | 7.7 | 8.3 | 6.0 | 6.0 | 5.0 | 5.3 | 5.0 |
| Miyako | 6.7 | 1.3 | 4.0 | 8.3 | 4.3 | 5.0 | 5.7 |
| SS | 7.3 | 1.0 | 5.3 | 1.0 | 4.3 | 5.0 | 5.0 |
| ZEN-400 | 5.7 | 9.0 | 4.3 | 4.3 | 5.0 | 5.0 | 5.3 |
| J-36 | 6.7 | 9.0 | 3.0 | 8.7 | 3.0 | 3.7 | 3.3 |
| ZEN-500 | 6.0 | 8.0 | 3.3 | 3.0 | 3.3 | 3.3 | 3.3 |
| Chinese Common | 4.7 | 9.0 | 2.0 | 7.0 | 3.0 | 3.3 | 3.7 |
| Korean Common | 4.7 | 1.0 | 1.0 | 1.0 | 3.3 | 3.7 | 4.3 |
| LSD 0.5 | 0.8 | 1.1 | 1.1 | 0.7 | 1.3 | 1.1 | 1.2 |

| | Turf Quality | | | | | | |
|----------------|--------------|-----|-----|------|----------------|------------|--|
| | Aug | Sep | Oct | Avg | % Sum Cover | % WtrKl | |
| HT-210 | 9.0 | 9.0 | 9.0 | 9.0 | 1.0 | 1.0 | |
| DALZ 9601 | 9.0 | 9.0 | 9.0 | 8.83 | 2.0 | 3.3 | |
| Zeon | 8.7 | 9.0 | 9.0 | 8.44 | 1.7 | 2.0 | |
| FR | 8.3 | 9.0 | 9.0 | 8.22 | 1.0 | 1.0 | |
| Emerald | 8.3 | 8.0 | 8.0 | 8.17 | 2.3 | 4.7 | |
| DeAnza | 8.3 | 8.0 | 8.0 | 8.00 | 1.3 | 1.0 | |
| Meyer | 8.3 | 7.3 | 7.3 | 7.83 | 3.0 | 8.7 | |
| J-14 | 8.0 | 7.0 | 7.0 | 7.72 | 3.7 | 8.7 | |
| Victoria | 7.0 | 6.7 | 6.7 | 6.83 | 1.0 | 1.7 | |
| OH-1 | 6.7 | 8.0 | 9.0 | 6.83 | 1.0 | 1.3 | |
| JaMur | 7.0 | 5.7 | 5.0 | 6.50 | 1.0 | 1.7 | |
| 2040 | 6.7 | 7.0 | 7.0 | 6.44 | 1.0 | 1.0 | |
| El Toro | 6.3 | 5.3 | 5.0 | 6.22 | 4.0 | 2.0 | |
| J-37 | 6.3 | 6.0 | 6.3 | 6.00 | 6.0 | 9.0 | |
| Zenith | 6.0 | 6.7 | 7.0 | 5.83 | 5.0 | 8.3 | |
| Miyako | 5.3 | 5.3 | 5.0 | 5.11 | 2.3 | 1.3 | |
| SS | 5.0 | 5.0 | 5.0 | 4.89 | 1.0 | 1.0 | |
| ZEN-400 | 5.0 | 4.3 | 4.3 | 4.83 | 6.3 | 8.7 | |
| J-36 | 3.7 | 4.3 | 4.0 | 3.67 | 4.3 | 8.3 | |
| ZEN-500 | 3.0 | 3.3 | 3.7 | 3.33 | 3.0 | 5.3 | |
| Chinese Common | 3.3 | 3.0 | 2.7 | 3.17 | 6.7 | 9.0 | |
| Korean Common | 3.3 | 2.0 | 1.7 | 3.06 | 5.0 | 1.0 | |
| LSD 0.5 | 1.2 | 1.3 | 1.5 | 0.94 | 0.9 | 0.8 | |

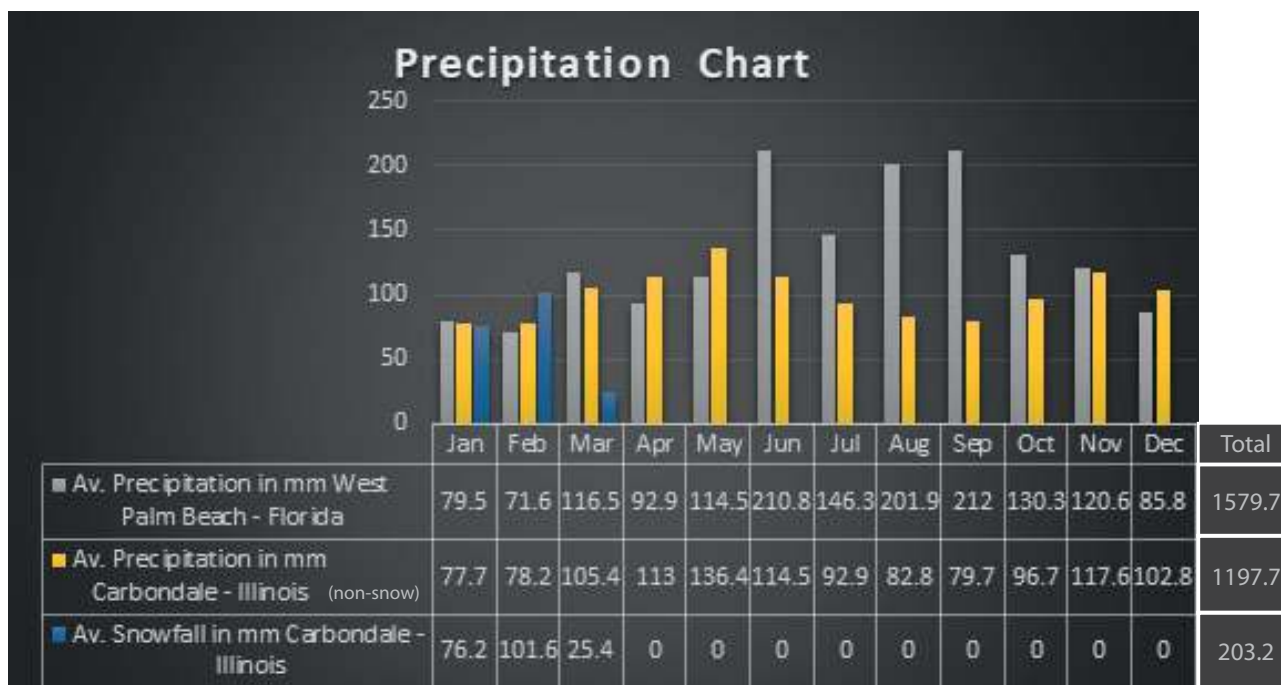
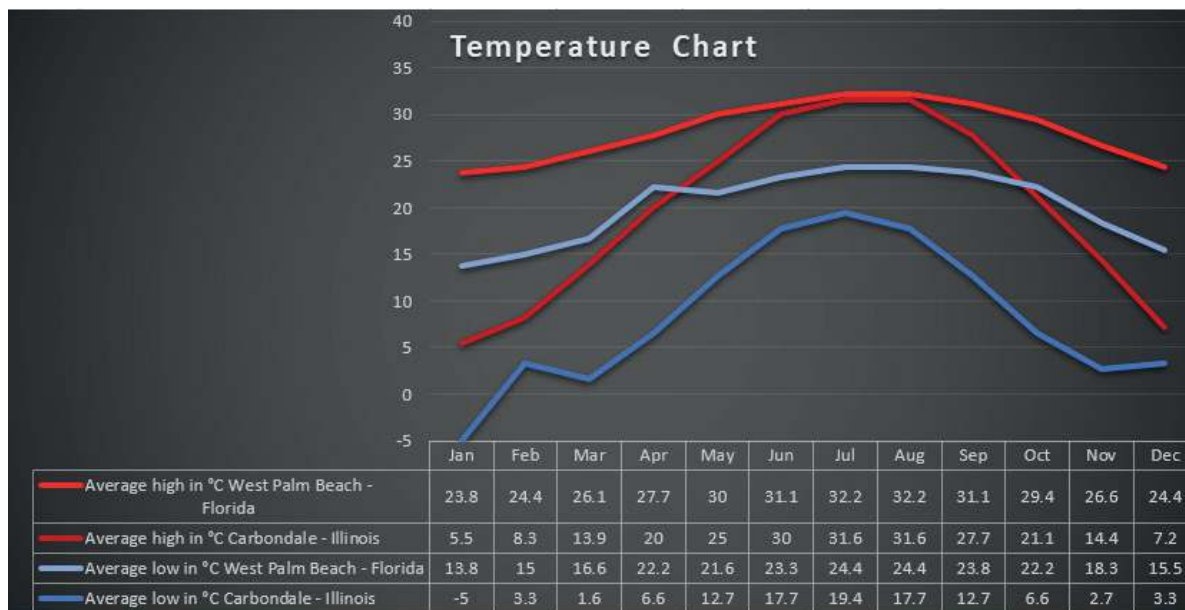
WtrKl = Winter Kill

Spg Grnp = Spring Greenup

Sum = Summer

Jvn Vgr = Juvenile Vigor

For ease of comparison, temperature and precipitation are significantly different between the NTEP location Carbondale, Illinois, and the original West Palm Beach location of 'BA-305'. Carbondale is colder every month of the year, averages three months of snow fall per annual, and has far less precipitation than West Palm Beach.



Summary

Taken together, 'BA-305' exhibited a significant improvement over Emerald and other zoysias in the market, and should have a competitive advantage over Emerald in specific applications within the zoysiagrass market, particularly warmer and wetter climates including subtemperate, subtropical and tropical regions of the southern U.S., the Caribbean basin, and Southeast Asia.

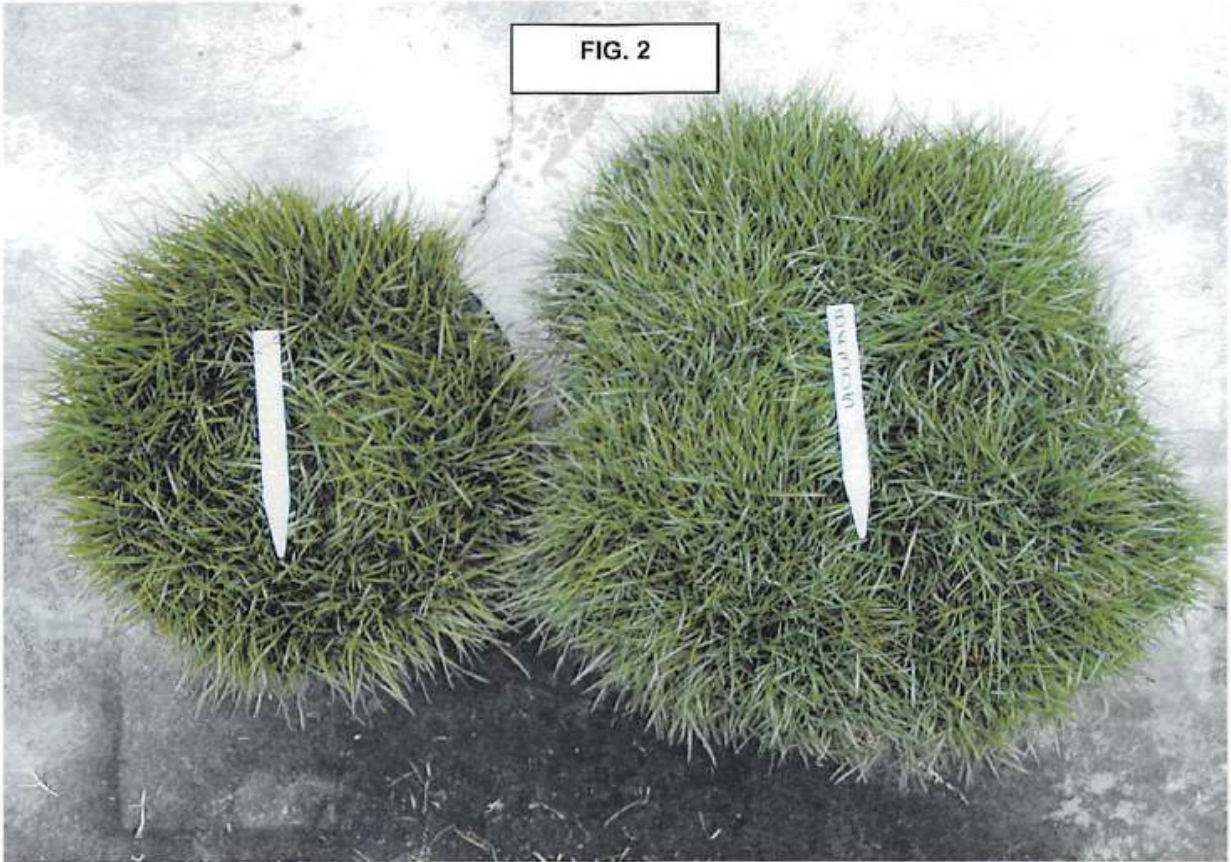
Following are photos attached with the original BA-305 patent filing.

'BA-305' (Prestine) [Toccoa]
Application No. 11/174,338
Brian T. Scully (772) 468-3922

FIG. 1



'BA-305' (Prestine) [Toccoa]
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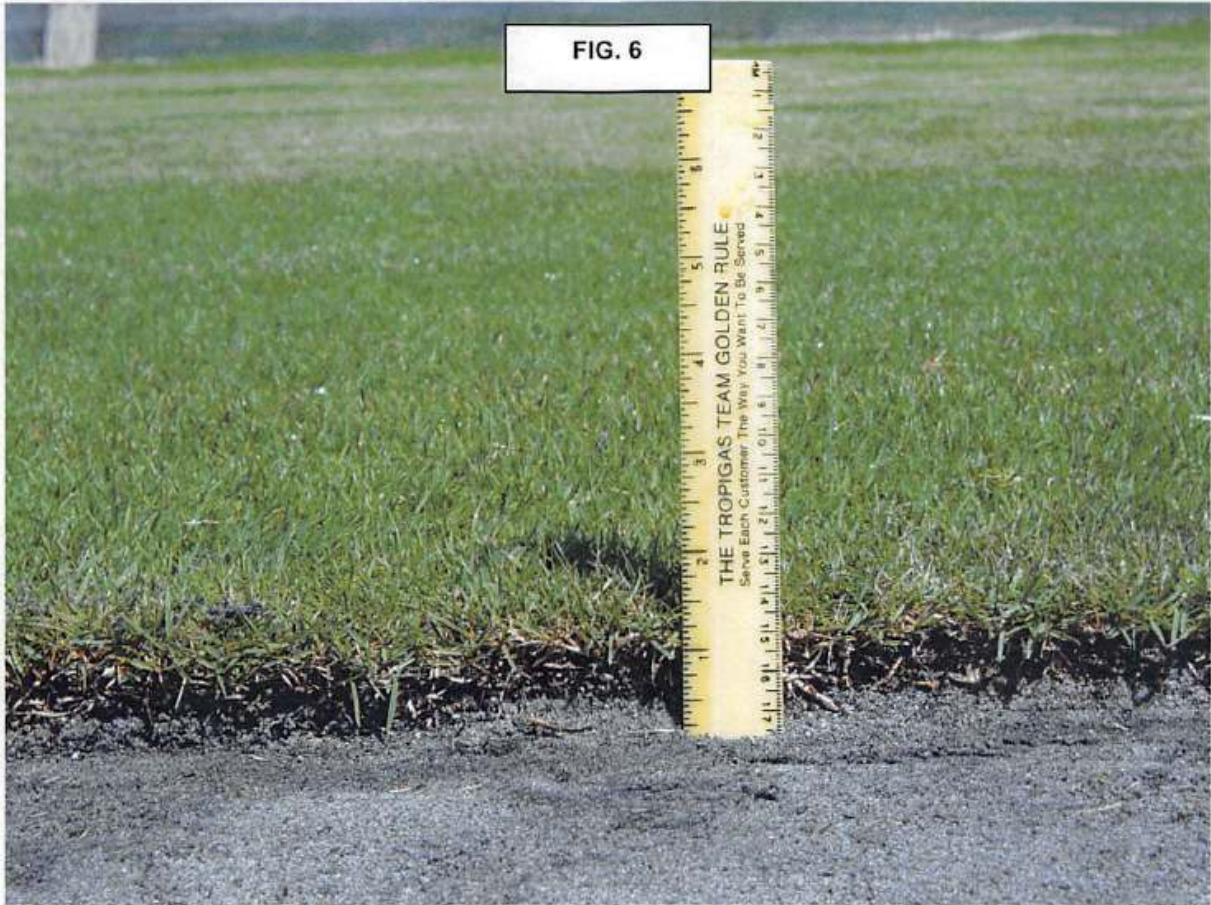
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Technical Bulletin compiled by Outfield Nursery Enterprises, Ltd. (ONE) from published Certification Submission, Cultivar report in the Journal of Plant Registrations, and patent filings.