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(54) **ST. AUGUSTINEGRASS PLANT NAMED 'XSA 11377'**

(50) Latin Name: ***Stenotaphrum secundatum* (Walt.) Kuntze**
Varietal Denomination: **XSA 11377**

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(52) **U.S. Cl.**
USPC **Plt./392**

(58) **Field of Classification Search**
USPC Plt./392
See application file for complete search history.

(56) **References Cited**

PUBLICATIONS

Van der Laat, R. et al. "Variation in southern chinch bug (Blissus insularis) survival and damage on St. Augustinegrass germplasm", Apr. 29, 2021, International Turfgrass Society Research Journal; vol. 14, issue 1, p. 642-651 URL: https://onlinelibrary.wiley.com/doi/epdf/10.1002/its2.67.*
"NC State University Releases Sola™, the Newest St.Augustinegrass" https://cals.ncsu.edu/crop-and-soil-sciences/news/nc-state-university-releases-sola-the-newest-st-augustinegrass/ (7 pages) (Aug. 15, 2022).
Sod Solutions Professionals "NC State University Releases Sola™, the Newest St.Augustinegrass" https://sodsolutionspro.com/nc-state-university-releases-sola-the-newest-st-augustinegrass/ (8 pages) (2022).
Busey , et al., "Genetic and environmental determinants of zoysiagrass adaptation in a subtropical region", The Journal of the American Society for Horticultural Science, 107:79-82, 1982.
Busey, Philip , "St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze", pp. 309-329 In: MD Casler and RR Duncan, Turfgrass Biology, Genetics, and Breeding, John Wiley & Sons, Hoboken, NJ (2003).
Busey , et al., "Turfgrass in the shade environment", Proceedings of the Florida State Horticultural Society, 104:353-358, 1991.
Carbajal , et al., "Identification of sources of resistance to gray leaf spot in *Stenotaphrum* germplasm", Crop Science, 61:3069-3079, 2021.
Dice, Lee R., "Measures of the Amount of Ecologic Association Between Species", Ecology, 26:297-302, 1945.
Jha, Puja , "Assessing sod production characteristics: sod handling quality and sod tensile strength of warm-season turfgrasses", MS Thesis from Oklahoma State University (72 pages) (Dec. 2018).
Milla-Lewis , et al., "Cytological and molecular characterization of genetic diversity in *Stenotaphrum*", Crop Science, 53(1):296-308, 2013.
Miller, Grady , "2023 Sod producers' report for North Carolina", NC State Extension Publication AG-809 (10 pages) (Jun. 8, 2023).
Morris , et al., "NTEP turfgrass evaluation guidelines", https://www.ntep.org/pdf/ratings.pdf (5 pages) (1998).
Mulkey , et al., "Development and characterization of simple sequence repeat (SSR) markers for St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze)", Crop Science, 54:401-412, 2014.
Mulkey , et al., "Genetic analysis of a St. Augustinegrass germplasm collection using AFLP markers and flow cytometry", International Turfgrass Society Research Journal, 12:281-291, 2013.
Rohlf, James F., "NTSYS-PC: Numerical Taxonomy and Multivariate Analysis System: Getting Started Guide", Department of Ecology and Evolution State University of New York, Version 2.2. Exeter Software, Setauket, NY. (2000).
Sokal , et al., "A Statistical Method for Evaluating Systematic Relationships", The University of Kansas Science Bulletin, 28(22):1409-1438, 1958.

* cited by examiner

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(57) **ABSTRACT**

'XSA 11377' is a new St. Augustinegrass cultivar that is fast to establish, has good levels of shade and drought tolerances, and has superior turf quality. It is distinguishable from other cultivars by its medium-fine texture, aggressive stoloniferous growth, improved sod strength, and improved shade tolerance. 'XSA 11377' shows gray leaf spot and chinch bug tolerance, and maintains above average turf quality under normal management practices. 'XSA-11377' is also genetically distinct from other St. Augustinegrass cultivars currently in the marketplace known to the Inventor.

29 Drawing Sheets

Specification includes a Sequence Listing.

STATEMENT OF GOVERNMENT SUPPORT

This invention was made with government support under grant number 2019-51181-30472 awarded by the National Institute of Food and Agriculture (USDA/NIFA). The government has certain rights in the invention.

Latin name of the genus and species: The Latin name of the novel grass cultivar disclosed herein is *Stenotaphrum secundatum* (Walt.) Kuntze.

Variety denomination: The inventive cultivar of *Stenotaphrum secundatum* disclosed herein has been given the varietal denomination 'XSA 11377'.

STATEMENT REGARDING ELECTRONIC FILING OF A SEQUENCE LISTING

A Sequence Listing in XML format, entitled 5051-1016_ST26.xml, 29,061 bytes in size, generated on Oct. 5, 2023, and filed herewith, is hereby incorporated by reference in its entirety for its disclosures.

BACKGROUND OF THE INVENTION

'XSA 11377' is a new St. Augustinegrass cultivar that is fast to establish, has good levels of shade and drought tolerances, and has superior turf quality. Furthermore, this cultivar has gray leaf spot and chinch bug tolerance, improved sod strength, and maintains above average turf quality under normal management practices. It comprises traits well suited for home lawns and landscapes in the southern US and into the transition zone.

SUMMARY OF THE INVENTION

'XSA 11377' is a perennial St. Augustinegrass that spreads by stolons and was identified in 2013 because of its superior turf quality and aggressive growth from a collection of St. Augustinegrass plants that were evaluated under cultivated conditions in Raleigh, Jackson Springs, and Laurel Springs, North Carolina. 'XSA 11377' can be distinguished from other St. Augustinegrasses by its medium-fine texture, aggressive stoloniferous growth, superior sod strength, and improved shade tolerance. Additionally, Simple Sequence Repeat (SSR) data shows 'XSA 11377' is genetically distinct from all major St. Augustinegrass cultivars currently on the market known to the Inventor. 'XSA 11377' is fast to establish, has good levels of shade and drought tolerances, and has superior turf quality over St. Augustinegrass cultivar 'Raleigh'. Furthermore, in comparison to 'Raleigh', this cultivar has better gray leaf spot and chinch bug tolerance, and significantly better sod strength, traits that are desirable to reduce management costs and increase harvest ability in sod production.

BRIEF DESCRIPTION OF THE DRAWINGS

The photographs in the drawings were made using conventional techniques and show the colors as true as reasonably possible by conventional photography. Colors in the photographs may differ slightly from the color values cited in the detailed botanical description, which accurately describe the colors of the new *Stenotaphrum secundatum* St. Augustinegrass 'XSA 11377'.

FIG. **1** is a color photograph of stolons of a typical specimen of the claimed plant.

FIG. **2** is a color photograph of a stolon of a typical specimen of the claimed plant.

FIG. **3** is a color photograph of leaf blades of a typical specimen of the claimed plant.

FIG. **4** is a color photograph of hairs of a typical specimen of the claimed plant.

FIGS. **5**A-**5**B are color photographs of inflorescences of a typical specimen of the claimed plant.

FIGS. **6**A-**6**C are color photographs of plots of a typical specimen of the claimed plant.

FIGS. **7**A-**7**D show images of data plots representing mean performance across locations of breeding lines and commercial cultivars evaluated for turfgrass quality versus FIG. **7**A shows final establishment on year 1, FIG. **7**B shows drought tolerance, FIG. **7**C shows gray leaf spot incidence, and FIG. **7**D shows Southern Chinch Bug tolerance evaluated in replicated trials at the Raleigh, NC, Jackson Springs, NC, and Laurel Springs, NC sites. Filled circles on graphs correspond to commercial cultivars used for comparison ("checks"), while filled triangles correspond to experimental lines including 'XSA 11377'.

FIG. **8** shows images of bar graphs from analyses of Best linear unbiased predictor (BLUP) values of St. Augustinegrass breeding lines and commercial checks evaluated 2017-2019 at the Jackson Springs, NC site for establishment rate (EST), turf quality (TQ), gray leaf spot incidence (GLS), fall color (FC), winterkill (WK), and drought tolerance (Drought). * denotes genotypes that significantly outperformed the mean at **5**% probability by Student's t-test.

FIG. **9** shows images of bar graphs from analyses of BLUP values for St. Augustinegrass breeding lines and commercial checks evaluated 2017-2019 at the Crosby, TX site for establishment (EST), turf quality (TQ), and genetic color (Color). * denotes genotypes that significantly outperformed the mean at 5% probability by t-Student test.

FIG. **10** shows images of bar graphs from analyses of BLUP values for St. Augustinegrass breeding lines by modified base index, and commercial checks evaluated 2018-2019 at the Burgaw, NC site for establishment (EST), percent green cover (PGC), turf quality (TQ), winterkill (WK), fall color (FC), drought tolerance (Drought), gray leaf spot incidence (GLS), and southern chinch bug incidence (SCB) . * denotes genotypes that significantly outperformed the mean at 5% probability by Student's t-test.

FIG. **11** shows an image of a bar graph from analyses of least squares (LS) means across ten measurements of sod tensile strength (measured as the peak fore required to tear the sod slab using a hand winch and force transducer/recorder system) in each of three replications at Burgaw, NC. Commercial cultivar 'Raleigh' was included as a control comparison ("check").

FIG. **12** shows images of bar graphs from analyses of predicted values of St. Augustinegrass breeding lines by modified base index, and commercial checks evaluated 2020-2021 under 63% shade in Raleigh, NC for EST=establishment, PGC=percent green cover, and TQ=turf quality. * denotes genotypes that significantly outperformed the mean at 5% probability by t-Student test.

FIGS. **13**A-**13**B show images of Principal Coordinate (PCO) analysis 2D (FIG. **13**A) and 3D (FIG. **13**B) plots of **24** St. Augustinegrass commercial cultivars and 'XSA 11377' generated using 134 Simple Sequence Repeat alleles. 'XSA 11377' and its two parents are circled.

FIGS. **14**A-**14**B show image of gels displaying results of PCR amplification of 24 St. Augustinegrass commercial cultivars and 'XSA 11377' with simple sequence repeat primer pair 17792 (FIG. **14**B) or simple sequence repeat primer pair 29269 (FIG. **14**B).

DETAILED BOTANICAL DESCRIPTION OF THE NEW VARIETY

The following is a detailed description of the botanical characteristics of a new and distinct cultivar of *Stenotaphrum secundatum* St. Augustinegrass plant known by the cultivar name 'XSA 11377'. All colors cited herein refer to The Royal Horticulture Society Colour Chart designations (The Royal Horticultural Society, London, Flower Council of Holland 1986 edition) except where general terms of ordinary dictionary significance are used. Where dimensions, sizes, colors, and other characteristics are given, it is to be understood that such characteristics are approximations or averages set forth as accurately as practicable.

This invention relates to a new and unique cultivar of perennial St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze) designated as 'XSA 11377'. 'XSA 11377' is an F1 hybrid that was produced in Raleigh, North Carolina (NC) in the Fall of 2011 by crossing cultivar 'Raleigh' (unpatented) as the female parent with pollen of plant introduction (PI) 410353 (National Plant Germplasm System, USDA). Crosses of 'Raleigh' by PI 410353 were manually made in 2011 under greenhouse and laboratory conditions.

'Raleigh' and PI 410353 were grown in greenhouses for production of inflorescences. Once 'Raleigh' started producing tillers with opening inflorescences, the tillers were collected (with at least two internodes and healthy enough for root production) and transported to the laboratory where they were placed in test tubes with water. Test tubes were labeled and placed in a container with humidity over 70% and temperature around 22-25° C. To avoid pollen contamination, anthers were removed twice a day, early in the morning and before making the crosses. In the greenhouses, pollen from PI 410353 was collected in petri dishes and pollen grains were transported to the lab where it was spread on stigmas using a brush. Pollinated flowers reached maturity after four weeks at which time seeds were manually harvested with forceps. Harvested seeds were germinated in petri dishes for six weeks. Seedlings were then transferred to potting soil and grown in the greenhouse, where they reached maturity in azalea pots (6 in. diameter×4¼ in. tall).

'XSA 11377' was first vegetatively propagated in Raleigh, NC in 2012 by rooting nodes and stolons in potting soil. Asexually reproduced plants of 'XSA 11377' have remained stable and true to type through at least 10 successive cycles of vegetative propagation. 'XSA 11377' has been determined to be diploid (2n=2x=18).

'XSA 11377' has not been observed under all possible environmental conditions; therefore, the phenotype may vary under different environmental conditions such as season, temperature, light intensity, day length, cultural conditions, and the like, without however, any variance in the genotype.

Leaf blades:
- *Length*.—30 mm.
- *Width*.—7 mm.
- *Shape*.—Blunt: not hairy.
- *Apex*.—Boat shaped.
- *Aspect*.—Concave.
- *Margin*.—Smooth.
- *Auricle*.—Absent.
- *Collar*.—Continuous.
- *Sheath*.—Open.
- *Leaf bud*.—Rolled.
- *Ligule type*.—Short fringe of hairs.
- *Leaf blade color of adaxial surface*.—RHS 137D: Green-Group.
- *Leaf blade color of abaxial surface*.—RHS 137C: Green-Group.
- *Venation*.—Parallel.

Stolons:
- *Internode length*.—50.8 mm.
- *Internode color*.—RHS 199A: Grey-Brown-Group.
- *Internode diameter*.—2.5 mm.
- *Apical meristem first leaf*.—29.9 mm.
- *Node diameter*.—4.4 mm.
- *Node color*.—RHS 199B: Grey-Brown-Group.

Inflorescence:
- *Inflorescence length*.—4.40 mm.
- *Inflorescence color*.—RHS 199A: Grey-Brown-Group.
- *Inflorescence diameter*.—5 mm.
- *Inflorescence stigmas color*.—RHS 83A: Violet-Group.
- *Inflorescence anther color*.—RHS 31A: Orange-Red Group.

FIGS. **1**-**6**A-**6**C provide photographic images of the claimed plant. In particular, FIG. **1** shows an example of stolons of a typical specimen of 'XSA 11377'. FIG. **2** shows an example of a singular stolon of a typical specimen of 'XSA 11377'. FIG. **3** shows an example of leaf blades of a typical specimen of 'XSA 11377'. FIG. **4** shows an example of leaf hairs of a typical specimen of 'XSA 11377'. FIGS. **5**A-**5**B show examples of inflorescences of a typical specimen of 'XSA 11377'. FIGS. **6**A-**6**C show examples of plots of a typical specimen of 'XSA 11377'. In particular, FIG. **6**A shows conditions under full management at Raleigh, NC, FIG. **6**B shows a plot evaluated for sod strength, and FIG. **6**C shows a plot of early establishment of a breeders block.

Morphological analysis of 'XSA 11377' and comparison to other St. Augustinegrass cultivars: 'XSA 11377' was morphologically compared to commercial cultivars 'Captiva' [U.S. Plant Pat. No. 21,280 as 'NUF-76'; marketed under tradename Captiva®], 'CitraBlue' [U.S. Plant Pat. No. 32,456 as 'FSA1602'; marketed under tradename CitraBlue®], 'Floratam' [unpatented], 'Palmetto' [U.S. Plant Pat. No. 9,393 as 'SS-100'; marketed under tradename Palmetto™], 'Raleigh' (female parent), 'Seville' [U.S. Plant Pat. No. 4,097], 'TamStar' [U.S. Plant Pat. No. 27,393 as 'DALSA 0605'; marketed under tradename TamStar®], and 'Texas Common' [unpatented]. List of patent statuses of commercial cultivars provided in Table 8. SUNGRO® HOTICULTURE MM830)-F3B 2.8 Cu ft soil enriched with 50-60% sphagnum peat moss, softwood bark, perlite and dolomite limestone was used for propagation. Plant material was propagated into 12.5 cm-diameter by 8.9 cm-deep pots for a total of three pots per entry. Plant materials were established in January 2023 and grown through April 2023 inside a greenhouse in Raleigh NC. 20 to 30° C. Pots were fertilized every 45 days using Turf Builder Southern Lawn Food (32-0-10) from Scotts R. Watering was performed as needed, about four to five times per week. Light requirements included natural sunlight only. Pots were left without mowing to trigger stolon development around the pots. Fifteen weeks after propagation, digital calipers (6 inches precision measuring tool) were used to collect morphological data. Morphological measurements were taken on internode length, internode diameter and node diameter. From each of the three pots per cultivar, nine measurements were collected per trait. Internode diameter and length were measured using the space between the fourth and fifth nodes, while the stolon node diameter was measured at the fourth node. Leaf length and width were collected from the third youngest leaf. In addition, length of the first leaf at the apical meristem was measured separately. Inflorescence measurements were collected on mature spikes with six measurements in total being collected per spike. Collected data were analyzed using LSD ($P \leq 0.05$) in R. Means followed by the same letter are not significantly different at $P=0.05$.

TABLE 1

Internode length (mm) of St. Augustinegrass commercial cultivars, measured under greenhouses conditions.			
N	ENTRY	INTERNODE LENGTH	GROUP
1	'Captiva'	29.7	f
2	'CitraBlue'	30.1	f
3	'Floratam'	63.9	bc
4	'Palmetto'	47.7	e
5	'Raleigh'	67.4	abc
6	'Seville'	43.5	e
7	'XSA 11377'	50.8	de
8	'TamStar'	58.5	cd
9	'Texas Common'	67.8	ab

TABLE 2

Internode diameter (mm) of St. Augustinegrass commercial cultivars, measured under greenhouses conditions.			
N	ENTRY	INTERNODE DIAMETER	GROUP
1	'Captiva'	2.2	e
2	'CitraBlue'	4.3	a
3	'Floratam'	3.5	b
4	'Palmetto'	2.6	d
5	'Raleigh'	2.7	d
6	'Seville'	2.8	cd
7	'XSA 11377'	2.5	de
8	'TamStar'	3.2	b
9	'Texas Common'	2.5	de

TABLE 3

Node diameter (mm) of St. Augustinegrass commercial cultivars, measured under greenhouses conditions.			
N	ENTRY	NODE DIAMETER	GROUP
1	'Captiva'	4.4	de
2	'CitraBlue'	6.4	a
3	'Floratam'	5.0	bcd
4	'Palmetto'	4.0	e
5	'Raleigh'	5.3	b
6	'Seville'	4.7	bcd
7	'XSA 11377'	4.4	de
8	'TamStar'	5.1	bc
9	'Texas Common'	4.5	cde

TABLE 4

Leaf blade length (mm) of St. Augustinegrass commercial cultivars, measured under greenhouses conditions.			
N	ENTRY	LEAF BLADE LENGTH	GROUP
1	'Captiva'	23.2	e
2	'CitraBlue'	28.7	de
3	'Floratam'	34.9	bcd
4	'Palmetto'	37.8	b
5	'Raleigh'	39.0	b
6	'Seville'	37.0	bc
7	'XSA 11377'	30.0	cde
8	'TamStar'	59.7	a
9	'Texas Common'	38.2	b

TABLE 5

Leaf blade width (mm) of St. Augustinegrass commercial cultivars, measured under greenhouses conditions.			
N	ENTRY	LEAF BLADE WIDTH	GROUP
1	'Captiva'	4.5	d
2	'CitraBlue'	7.6	a
3	'Floratam'	7.2	a
4	'Palmetto'	5.9	bc
5	'Raleigh'	7.6	a
6	'Seville'	5.7	c
7	'XSA 11377'	7.0	ab
8	'TamStar'	7.9	a
9	'Texas Common'	6.1	bc

TABLE 6

First apical leaf length (mm) of St. Augustinegrass commercial cultivars, measured under greenhouses conditions.			
N	ENTRY	FIRST APICAL LEAF	GROUP
1	'Captiva'	30.8	d
2	'CitraBlue'	29.6	d
3	'Floratam'	60.4	b
4	'Palmetto'	31.5	d
5	'Raleigh'	36.6	cd
6	'Seville'	31.1	d
7	'XSA 11377'	29.9	d
8	'TamStar'	77.2	a
9	'Texas Common'	43.1	C

2016 Advanced Trial: The 2016 St. Augustinegrass Advanced Trial (16 SAT) was established in June of 2016 in three locations: Raleigh, Jackson Springs, and Laurel Springs, North Carolina (NC). Entries were planted in 3×3 ft plots with 1.5 ft alleys between entries in a Randomized Complete Block Design with three replications. Plots were evaluated 2016-2018 for establishment rate (0-100%), turf quality parameters (overall turfgrass quality, genetic color, leaf texture, density, uniformity—all rated on a scale 1-9 where 9=best), winterkill (rated on a scale 1-9 where 1=dead turf and 9=green, healthy turf), and response to any prevalent pests following National Turfgrass Evaluation Program (NTEP) guidelines (Morris and Shearman, 1998). Additionally, at Jackson Springs, NC, where sandy soils allow for the generation of drought conditions with relative ease, plots were evaluated for drought tolerance by cutting irrigation off during periods when no rain was forecasted and rating leaf firing (on a scale of 1-9 where 1=dead turf and 9=green, healthy turf). Epidemics of gray leaf spot (caused by *Pyricularia grisea*) occurred in Laurel Springs and Jackson Springs, NC in 2016, while an infestation of the southern chinch bug (*Blissus insularis*) was present in Jackson Springs, NC in 2018. Data on overall turf quality, final establishment in year 1 (a measure of a line's aggressiveness), gray leaf spot tolerance (0-100% where 100% severe disease) and southern chinch bug tolerance (rated 1-9) where 9=no damage) is presented in FIGS. **6**A-**6**D. 'XSA 11377' was the top performer in terms of establishment, drought tolerance and chinch bug tolerance. Furthermore, the cultivar was among the top performers for turfgrass quality and gray leaf spot tolerance. 'XSA 11377' outperformed the commercial cultivars for each of these tested traits.

Farm Trials: The best 2-3 lines from each the 2014, 2015, and 2016 Advanced Trials, including 'XSA 11377', were advanced to St. Augustinegrass On-Farm Trials (SOFT). Eight NC State (NCSU) lines, eight University of Florida (UF) lines, and commercial checks 'Raleigh', 'Palmetto', and 'CitraBlue' were established at sites at Jackson Springs, NC and Crosby, Texas (TX) in June of 2017. An additional copy of the trial was planted at Burgaw, NC, in July of 2018. Entries were planted in 5×5 ft plots with 1.5 ft alleys between entries in a Randomized Complete Block Design with three replications.

2017 Jackson Springs, NC SOFT: The 17 Jackson Springs NC SOFT was evaluated 2017-2019 for establishment rate, turf quality parameters (overall turf quality, genetic color, leaf texture, density and uniformity), winterkill, drought tolerance, fall color and response to any prevalent pests following National Turfgrass Evaluation Program (NTEP) guidelines. A late frost in May of 2018 following partial green up of the plots, caused severe winterkill on most entries. However, except for a few UF lines, most plots made a full recovery by summer of that year. No SCB infestations occurred during the life of the trial and only modest GLS incidence was observed in 2018. 'XSA 11377' significantly (p=0.05) outperformed the mean of all entries in terms of establishment rate and fall color (FIG. **8**). Additionally, it was numerically superior to all checks in EST, turf quality, fall color and drought tolerance.

2017 Crosby, TX SOFT: The trial was evaluated for establishment rate (EST) at the end of year 1, and turf quality and genetic color at the peak of season 2017-2018. 'XSA 11377' reached higher establishment than the checks at the end of year 1. The line was comparable to the checks in terms of TQ and Color (FIG. **9**).

2018 Burgaw, NC SOFT. This trial was of interest because environmental conditions (soil type, humidity and temperature) at this site are conducive for heavy gray leaf spot and southern chinch bug infestations. Severe epidemics of both of these pest occurred in 2019. Because of severe plot loss for some of the entries, the plots were evaluated for final percent cover as a measure of overall stress tolerance and persistence. At this site, 'XSA 11377' significantly (p=0.05) outperformed the mean in establishment rate. It was the best line in drought tolerance, third in winterkill, and fourth in fall color. While 'XSA 11377' is not completely resistant to chinch bugs and gray leaf spot, it outperformed both 'Raleigh' and 'Seville' for the second, and 'Raleigh' for the first. Furthermore, under such high incidence of both pathogens, 'XSA 11377' ranked second in percent green cover at the end of the year and third in overall turf quality across years of evaluation (FIG. **10**).

Production Trials: In August 2019, the best four performing lines in the SOFT trials and cultivar 'Raleigh' were planted in 8×12 ft strips at Burgaw, NC and Crosby, TX to evaluate sod production traits. At Burgaw, NC, three sod strips 12 inches in width and 20 ft in length were mechanically harvested using commercial equipment. Each strip was then cut into 18-inch pieces. Each of 10 sod slabs per strip were evaluated for sod tensile strength. The tensile strength was measured as the peak force required to tear the sod slab using a hand winch and force transducer/recorder system (Jha. 2018). 'XSA 11377' was in the top group of performance and was significantly (p=0.05) better than 'Raleigh' (FIG. **11**).

At the Crosby TX site, 10 sod pieces 12 inches in width and 18 inches in length were mechanically harvested using commercial equipment. Tensile strength was evaluated by lifting the sod pieces by a corner and rating their ability to stay intact on a scale of 1-9 (1=poor and 9=excellent) per NTEP guidelines. Means across samples are presented in Table 7.

Shade Trial. A shade trial was established at the Raleigh, NC site in summer 2020. The trial was planted under a structure fitted with a 63% shade cloth. Eleven breeding lines from the NC State (NCSU) turfgrass breeding program, eight from University of Florida (UF), eight from Texas A&M University (TAMU), and three controls ('Raleigh', 'Palmetto' and 'DALSA 1404') were established from 10×7 inch plugs in 9 sq ft plots in a Randomized Complete Block Design with three replications. The trial was evaluated 2020-2021 for establishment rate (EST), percent green cover (PGC), and turf quality (TQ) all under shade. 'XSA 11377' exhibited superior performance under shade, significantly (p=0.05) outperforming the mean for PGC and TQ (FIG. **12**). Furthermore, 'XSA 11377' ranked first for EST and TQ, and second for PGC.

DNA Fingerprinting. In order to demonstrate that 'XSA 11377' is a unique genotype and genetically different from all major St. Augustinegrass cultivars currently on the market known to the Inventor, simple sequence repeat (SSR) markers were used to generate DNA fingerprints of these materials. Twenty three commercial cultivars (Table 8). 'XSA 11377' and its two parents, cultivar 'Raleigh' (female parent) and PI 410353 (male parent), were genotyped with 16 SSR primer pairs (Table 9) developed by Mulkey et al. (2014). A total of 16 loci were amplified (one locus per primer pair). The number of alleles per locus ranged between 5 and 13 for a total of 134 alleles analyzed (Table 9). Levels of polymorphism among the materials analyzed were comparable to those found in previous studies (Milla-Lewis et al., 2013; Mulkey et al, 2013; 2014). Genetic similarity values were calculated for all pairwise genotype combinations according to Dice (1945) using NTSYSpc v 2.2. (Rohlf, 2000). Dice similarities were then used to construct a dendrogram using the UPGMA (Sokal and Michener, 1958) clustering procedure in order to assess genetic relationships among genotypes. Additionally, a principal coordinate analysis (PCO) was performed for the same purpose. Both the dendrogram and the PCO plots (FIGS. **13**A-**13**B) showed clear separation between 'XSA 11377' and all other commercial cultivars currently in the market known to the Inventor, indicating the genetic distinctness of this line. Furthermore, only one SSR primer was sufficient to separate 'XSA 11377' from all other cultivars tested. Examples of this are SSR profiles of primer 17792 (FIG. **14**A) and primer 29269 (FIG. **14**B). The SSR data presented here further indicates that 'XSA 11377' is a unique genotype.

Based on available data, 'XSA 11377' is unique not only because SSR data shows it is genetically distinct from all major St. Augustinegrass cultivars currently on the market known to the Inventor, but also because it is fast to establish, has good levels of shade and drought tolerances, and has superior turf quality over the cultivar 'Raleigh'. Furthermore, in comparison to 'Raleigh', this cultivar has slightly better gray leaf spot and chinch bug tolerance, and significantly better sod strength, traits that are desirable to reduce management costs and increase harvest ability in sod production. Overall, 'XSA 11377' maintains acceptable turf quality under normal management practices (FIGS. **6**A-**6**C) making it a desirable grass for home lawns and landscapes in the southern US and into the transition zone. Turf quality

(TQ) is based on 9 being outstanding or ideal turf and 1 being poorest or dead. A rating of 6 or above is generally considered acceptable.

TABLE 7

Data collected on slab quality for sod quality evaluations at Crosby, TX.

Entries	Color	TQ	Tensile Strength
'Raleigh'	7	6	6
'XSA 11377'	8	8	8

TABLE 8

List of genotypes used for comparison of genetic similarity between 'XSA 11377' and major commercial cultivars of St. Augustinegrass.

Num.	Genotype	Source	Ploidy level
1	'Raleigh' [unpatented]	NC State University	Diploid (2n = 2X = 18)
2	PI410353*	Plant Genetic Resources Conservation Unit (Griffin, GA)	Diploid (2n = 2X = 18)
3	'Amerishade' [U.S. Plant Pat. No. 17,095 as 'TR 6-10'; marketed under tradename Amerishade ®]	Scotts ®	Diploid (2n = 2X = 18)
4	'Bitterblue' [unpatented]	Collection from farmer's fields	Triploid (2n = 3X = 27)
5	'Captiva' [U.S. Plant Pat. No. 21,280 as 'NUF-76'; marketed under tradename Captiva ®]	University of Florida	Diploid (2n = 2X = 18)
6	'CitraBlue' [U.S. Plant Pat. No. 32,456 as 'FSA 1602'; marketed under tradename CitraBlue ®]	University of Florida	Tetraploid (2n = 4X = 36)
7	'Classic' [unpatented]	Woerner Farms	Diploid (2n = 2X = 18)
8	'Delmar' [U.S. Plant Pat. No. 6,372]	Scotts ®	Diploid (2n = 2X = 18)
9	'DeltaShade' [unpatented]	Environmental Turf	Diploid (2n = 2X = 18)
10	'Eclipse' [U.S. Plant Pat. No. 21,603]	Mississippi State University	Diploid (2n = 2X = 18)
11	'Floralawn' [unpatented]	University of Florida	Triploid (2n = 3X = 32)
12	'Floratam' [unpatented]	University of Florida	Triploid (2n = 3X = 32)
13	'Floratine' [unpatented]	University of Florida	Triploid (2n = 3X = 27)
14	'FloraVerde' [unpatented]	University of Florida	Diploid (2n = 2X = 18)
15	'FX-10' [U.S. Plant Pat. No. 7,852]	University of Florida	Triploid (2n = 3X = 30)
16	'Jade' [U.S. Plant Pat. No. 6,921 as '6-72-182']	Scotts ®	Diploid (2n = 2X = 18)
17	'Majestic' [unpatented]	Collection from farmer's fields	Diploid (2n = 2X = 18)
18	'Palmetto' [U.S. Plant Pat. No. 9,395]	Sod Solutions Inc.	Diploid (2n = 2X = 18)
19	'Polaris' [U.S. Plant Pat. No. 21,240]	Mississippi State University	Diploid (2n = 2X = 18)
20	'Sapphire' [U.S. Plant Pat. No. 16,174 as 'B12'; marketed under tradename Sapphire ™]	Ozbreed Australia	Diploid (2n = 2X = 18)
21	'Seville' [U.S. Plant Pat. No. 4,097]	Scotts ®	Diploid (2n = 2X = 18)
22	'Sunclipse' [U.S. Plant Pat. No. 6,922 as '6-72-130']	Scotts ®	Diploid (2n = 2X = 18)
23	'TamStar' [U.S. Plant Pat. No. 27,393 as 'DALSA 0605'; marketed under tradename TamStar ®]	Texas AgriLife	Diploid (2n = 2X = 18)
24	'Texas Common' [unpatented]	Collection from farmer's fields	Diploid (2n = 2X = 18)
25	'Silk' [unpatented]	Mississippi State University	Diploid (2n = 2X = 18)

*Although not a cultivar, plant introduction 410353 was included in the analysis because it is the male parent of 'XSA 11377'.

TABLE 9

Summary statistics for Simple Sequence Repeat primers used to assess genetic relatedness among 'XSA 11377' and St. Augustinegrass commercial cultivars.

Primer Pair No.	Primer Name	No. of alleles amplified	Primer Sequence
1	1646	12	F (SEQ ID NO: 1): TTCATCTGTTGCCAATATACATCA R (SEQ ID NO: 2): GGGTAGGAATGAGGAATCCAA
2	1709	6	F (SEQ ID NO: 3): CTCGCGCCAAAGAAGAGG R (SEQ ID NO: 4): CCCGGGCTTGAATTGAC
3	2503	9	F (SEQ ID NO: 5): ACCTGGTACTGCAACCGTCT R (SEQ ID NO: 6): TCTCTCTAGTCTCTCTGAACTGAGC
4	17792	13	F (SEQ ID NO: 7): TCCTACAAGACAATCAAATCTGGA R (SEQ ID NO: 8): GGGCACACAATTGAGTTCAGTA
5	23060	7	F (SEQ ID NO: 9): GGCCTCCGACGAGGAATA R (SEQ ID NO: 10): ACTAGATCCACGGAGCAGGA
6	23965	8	F (SEQ ID NO: 11): CACGAGGCTGTACTACCACTCA R (SEQ ID NO: 12): TGAAATGTTAAGTTTGTGCGTGT
7	27477	9	F (SEQ ID NO: 13): GAGTGCTAGGCCCATGGTAA R (SEQ ID NO: 14): TATGCTACGCCGGCACTAA

TABLE 9-continued

Summary statistics for Simple Sequence Repeat primers used to assess genetic relatedness among 'XSA 11377' and St. Augustinegrass commercial cultivars.

Primer Pair No.	Primer Name	No. of alleles amplified	Primer Sequence
8	28514	7	F (SEQ ID NO: 15): CACGGAAATGTGGTTCATGTTT R (SEQ ID NO: 16): CTTGAATCGCACGGTCCATA
9	29269	8	F (SEQ ID NO: 17): ACCACCAACGGCAACAAC R (SEQ ID NO: 18): TCATCACATGATTGCATGCTT
10	29525	10	F (SEQ ID NO: 19): AGGCGCCTGCAGACATAGTA R (SEQ ID NO: 20): GGTATGGCTGCTCGTGTCA
11	29919	11	F (SEQ ID NO: 21): AAGCTGCTGGGGTGAGGT R (SEQ ID NO: 22): TTGAACAAGTTATTGGTGAAATGC
12	4327	9	F (SEQ ID NO: 23): AGGATTTGGTTTTCCTCTTCG R (SEQ ID NO: 24): ACAGCCTCGGAGCGAACT
13	4930	7	F (SEQ ID NO: 25): AAGTGATCGATCCCATCCTA R (SEQ ID NO: 26): CCTCAAAGCACGCACGTA
14	6099	7	F (SEQ ID NO: 27): AACGGGACATCCGGAGAG R (SEQ ID NO: 28): TCGAAGACGACGCACTTG
15	5258	6	F (SEQ ID NO: 29): CTGCCATCTGGAGCACAAC R (SEQ ID NO: 30): TGCTCTACTTCTTGATCCCAAAA
16	6818	5	F (SEQ ID NO: 31): TGTACTACCATGGAGATCAACTTGT R (SEQ ID NO: 32): TGGTATGGTGTGACTACCTTGTG
Total		134	
Average		8.38	
Min		5	
Max		13	

REFERENCES

Busey P, Reinert J A, Atilano R A (1982) Genetic and environmental determinants of zoysiagrass adaptation in a subtropical region. J Amer Soc Hort Sci 107:79-82

Busey P, Davis E H (1991) Turfgrass in the shade environment. Florida State Hort Soc Proc 104: 353-358

Busey P (2003) St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze pp 309-329 In: M D Casler and R R Duncan, Turfgrass Biology, Genetics, and Breeding, John Wiley & Sons, Hoboken, NJ

Dice, L. R. 1945. Measures of the amount of ecologic association between species. Ecology 26: 297-302.

Carbajal, E. M., B. Ma, M. C. Zuelta, W. C. Reynolds, C. Arellano, L. P. Tredway, and S. R. Milla-Lewis. 2021. Identification of sources of resistance to gray leaf spot in *Stenotaphrum* germplasm. Crop Science 61: 3069-3079 https://doi.org/10.1002/csc2.20371

Jha, P. 2018. Assessing sod production characteristics: sod handling quality and sod tensile strength of warm-season turfgrasses. MS Thesis from Oklahoma State University. December 2018. Available online.

Milla-Lewis, S. R., Zuleta, M. C., Van Esbroeck, G. A., Quesenberry, K. H., Kenworthy, K. E. 2013. Cytological and molecular characterization of genetic diversity in *Stenotaphrum*. Crop Sci. 53(1):296-308.

Miller, G. L. 2021. 2021 Sod producers' report for North Carolina. NC State Extension Publication AG-809, May 13, 2021. Available online.

Morris, K. N., and R. C. Shearman. 1998. NTEP turfgrass evaluation guidelines.

Mulkey, S. E., Zuleta, M. C., Van Esbroeck, G. A., Lu, H. J., Kenworthy, K. E., Milla-Lewis, S. R. 2013. Genetic analysis of a St. Augustinegrass germplasm collection using AFLP markers and flow cytometry. Intl. Turfgrass Soc. Res. J. 12:281-291

Mulkey, S. E., Zuleta, M. C., Keebler, J. E., Schaff, J. E., and Milla-Lewis, S. R. 2014. Development and characterization of simple sequence repeat (SSR) markers for St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze). Crop Sci. 54:401-412

Rohlf, F. J. 2000. NTSYS-PC: Numerical taxonomy and multivariate analysis system, version 2.2. Exeter Software, Setauket, NY.

Sokal, R. R., and Michener, C. D. 1958. A statistical method for evaluating systematic relationships. Univ. Kansas Sci. Bull. 28: 1409-1438.

SEQUENCE LISTING

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FEATURE               Location/Qualifiers
source                1..24
                      mol_type = other DNA
                      organism = synthetic construct
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FEATURE               Location/Qualifiers
source                1..21
                      mol_type = other DNA
                      organism = synthetic construct
SEQUENCE: 2
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SEQ ID NO: 3          moltype = DNA  length = 18
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FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 3
ctcgcgccaa agaagagg                                              18

SEQ ID NO: 4            moltype = DNA  length = 17
FEATURE                 Location/Qualifiers
source                  1..17
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 4
cccgggcttg aattgac                                               17

SEQ ID NO: 5            moltype = DNA  length = 20
FEATURE                 Location/Qualifiers
source                  1..20
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 5
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SEQ ID NO: 6            moltype = DNA  length = 25
FEATURE                 Location/Qualifiers
source                  1..25
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 6
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SEQ ID NO: 7            moltype = DNA  length = 24
FEATURE                 Location/Qualifiers
source                  1..24
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 7
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SEQ ID NO: 8            moltype = DNA  length = 22
FEATURE                 Location/Qualifiers
source                  1..22
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 8
gggcacacaa ttgagttcag ta                                         22

SEQ ID NO: 9            moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 9
ggcctccgac gaggaata                                              18

SEQ ID NO: 10           moltype = DNA  length = 20
FEATURE                 Location/Qualifiers
source                  1..20
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 10
actagatcca cggagcagga                                            20

SEQ ID NO: 11           moltype = DNA  length = 22
FEATURE                 Location/Qualifiers
source                  1..22
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 11
cacgaggctg tactaccact ca                                         22

SEQ ID NO: 12           moltype = DNA  length = 23
FEATURE                 Location/Qualifiers
source                  1..23
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 12
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```

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SEQ ID NO: 13           moltype = DNA  length = 20
FEATURE                 Location/Qualifiers
source                  1..20
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 13
gagtgctagg cccatggtaa                                                20

SEQ ID NO: 14           moltype = DNA  length = 19
FEATURE                 Location/Qualifiers
source                  1..19
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 14
tatgctacgc cggcactaa                                                 19

SEQ ID NO: 15           moltype = DNA  length = 22
FEATURE                 Location/Qualifiers
source                  1..22
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 15
cacggaaatg tggttcatgt tt                                             22

SEQ ID NO: 16           moltype = DNA  length = 20
FEATURE                 Location/Qualifiers
source                  1..20
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 16
cttgaatcgc acggtccata                                                20

SEQ ID NO: 17           moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 17
accaccaacg gcaacaac                                                  18

SEQ ID NO: 18           moltype = DNA  length = 21
FEATURE                 Location/Qualifiers
source                  1..21
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 18
tcatcacatg attgcatgct t                                              21

SEQ ID NO: 19           moltype = DNA  length = 20
FEATURE                 Location/Qualifiers
source                  1..20
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 19
aggcgcctgc agacatagta                                                20

SEQ ID NO: 20           moltype = DNA  length = 19
FEATURE                 Location/Qualifiers
source                  1..19
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 20
ggtatggctg ctcgtgtca                                                 19

SEQ ID NO: 21           moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 21
aagctgctgg ggtgaggt                                                  18

SEQ ID NO: 22           moltype = DNA  length = 24
FEATURE                 Location/Qualifiers
source                  1..24
                        mol_type = other DNA
                        organism = synthetic construct
```

-continued

```
SEQUENCE: 22
ttgaacaagt tattggtgaa atgc                                        24

SEQ ID NO: 23           moltype = DNA  length = 21
FEATURE                 Location/Qualifiers
source                  1..21
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 23
aggatttggt tttcctcttc g                                           21

SEQ ID NO: 24           moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 24
acagcctcgg agcgaact                                               18

SEQ ID NO: 25           moltype = DNA  length = 20
FEATURE                 Location/Qualifiers
source                  1..20
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 25
aagtgatcga tcccatccta                                             20

SEQ ID NO: 26           moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 26
cctcaaagca cgcacgta                                               18

SEQ ID NO: 27           moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 27
aacgggacat ccggagag                                               18

SEQ ID NO: 28           moltype = DNA  length = 18
FEATURE                 Location/Qualifiers
source                  1..18
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 28
tcgaagacga cgcacttg                                               18

SEQ ID NO: 29           moltype = DNA  length = 19
FEATURE                 Location/Qualifiers
source                  1..19
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 29
ctgccatctg gagcacaac                                              19

SEQ ID NO: 30           moltype = DNA  length = 23
FEATURE                 Location/Qualifiers
source                  1..23
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 30
tgctctactt cttgatccca aaa                                         23

SEQ ID NO: 31           moltype = DNA  length = 25
FEATURE                 Location/Qualifiers
source                  1..25
                        mol_type = other DNA
                        organism = synthetic construct
SEQUENCE: 31
tgtactacca tggagatcaa cttgt                                       25

SEQ ID NO: 32           moltype = DNA  length = 23
FEATURE                 Location/Qualifiers
source                  1..23
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-continued

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                         mol_type = other DNA
                         organism = synthetic construct
SEQUENCE: 32
tggtatggtg tgactacctt gtg                                              23
```

I claim:

1. A new and distinct cultivar of *Stenotaphrum secundatum* St. Augustinegrass plant named 'XSA 11377', substantially as illustrated and described herein.

* * * * *

FIG. 1

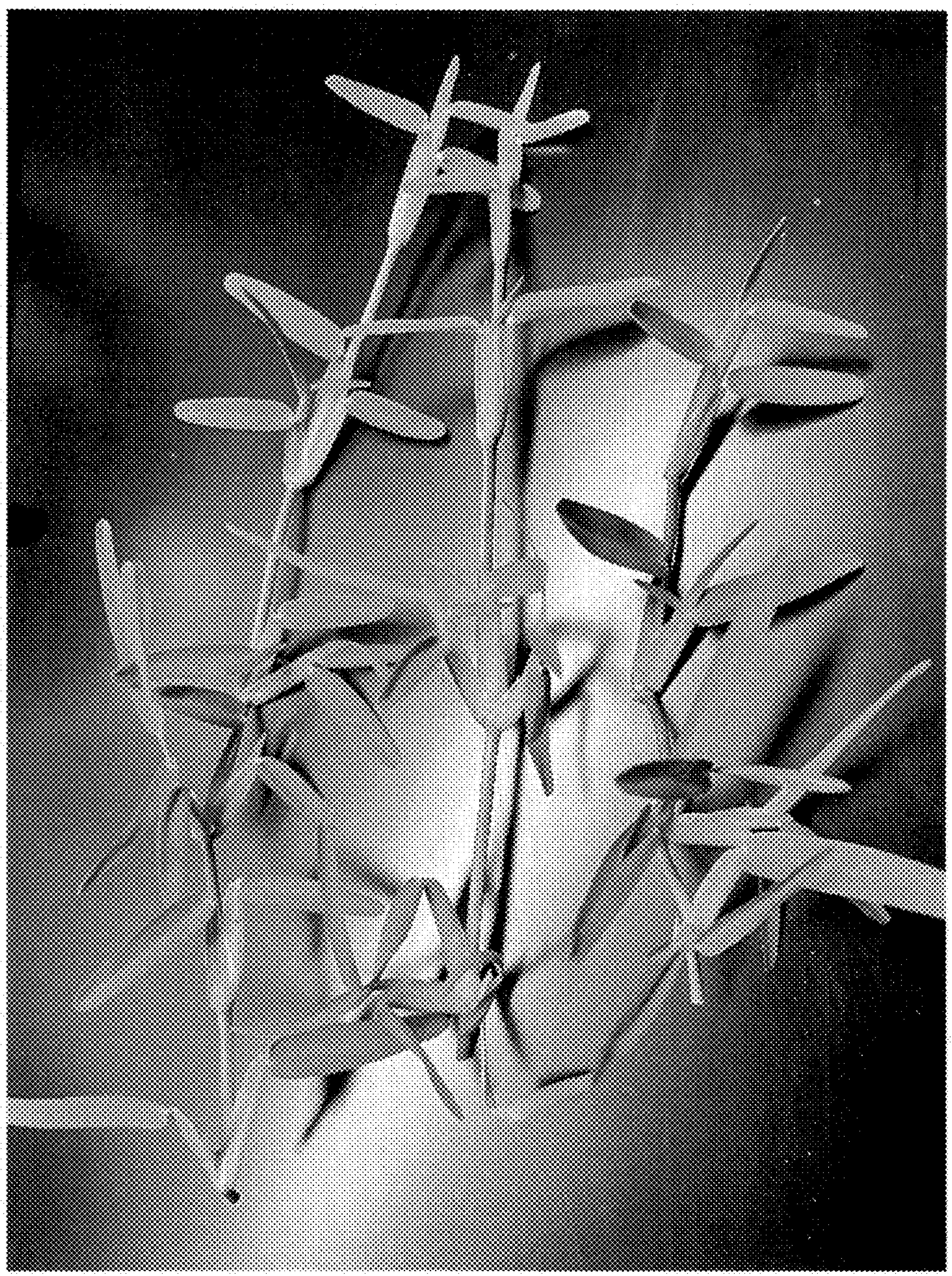


FIG. 2

FIG. 3

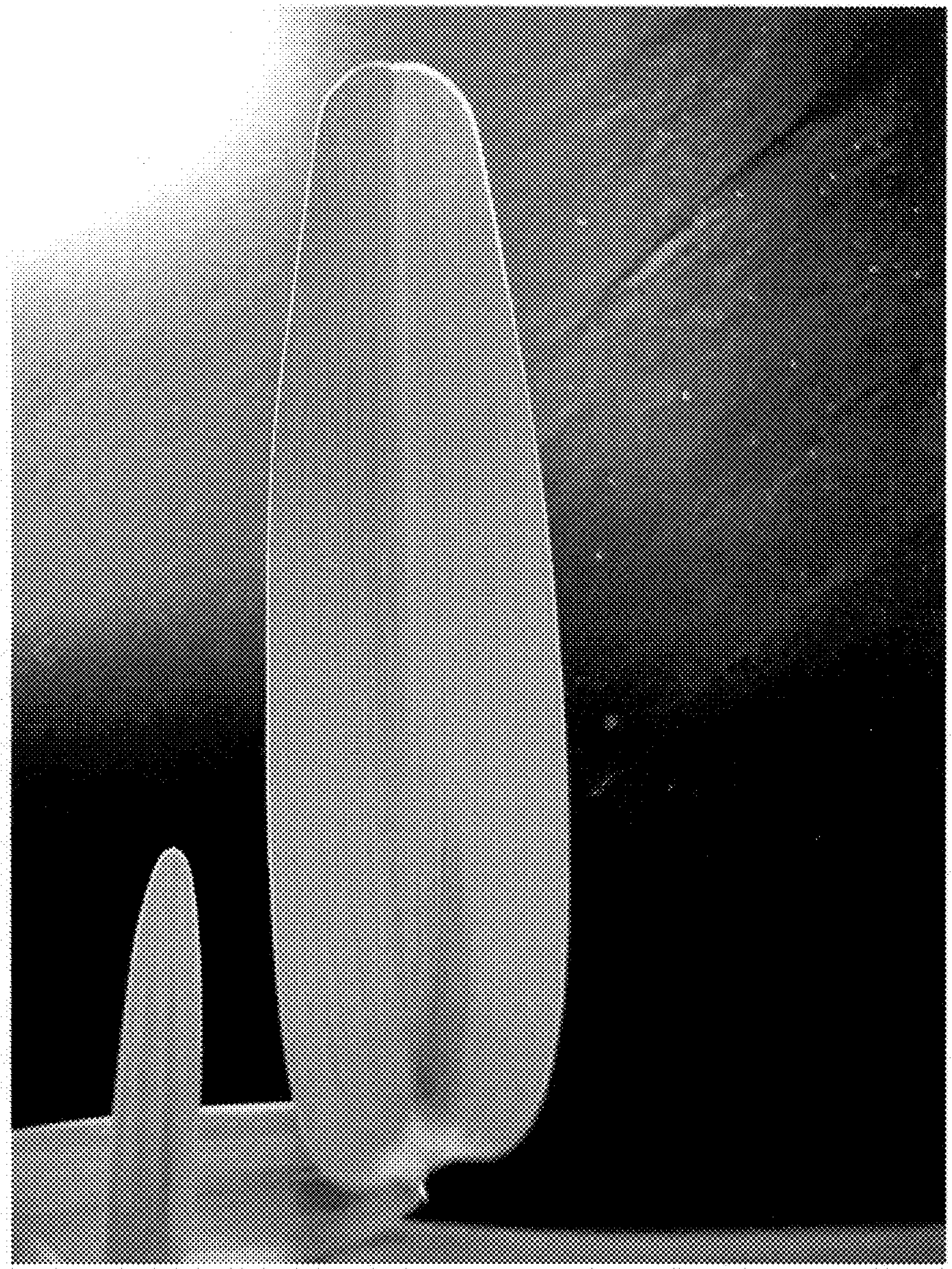


FIG. 4

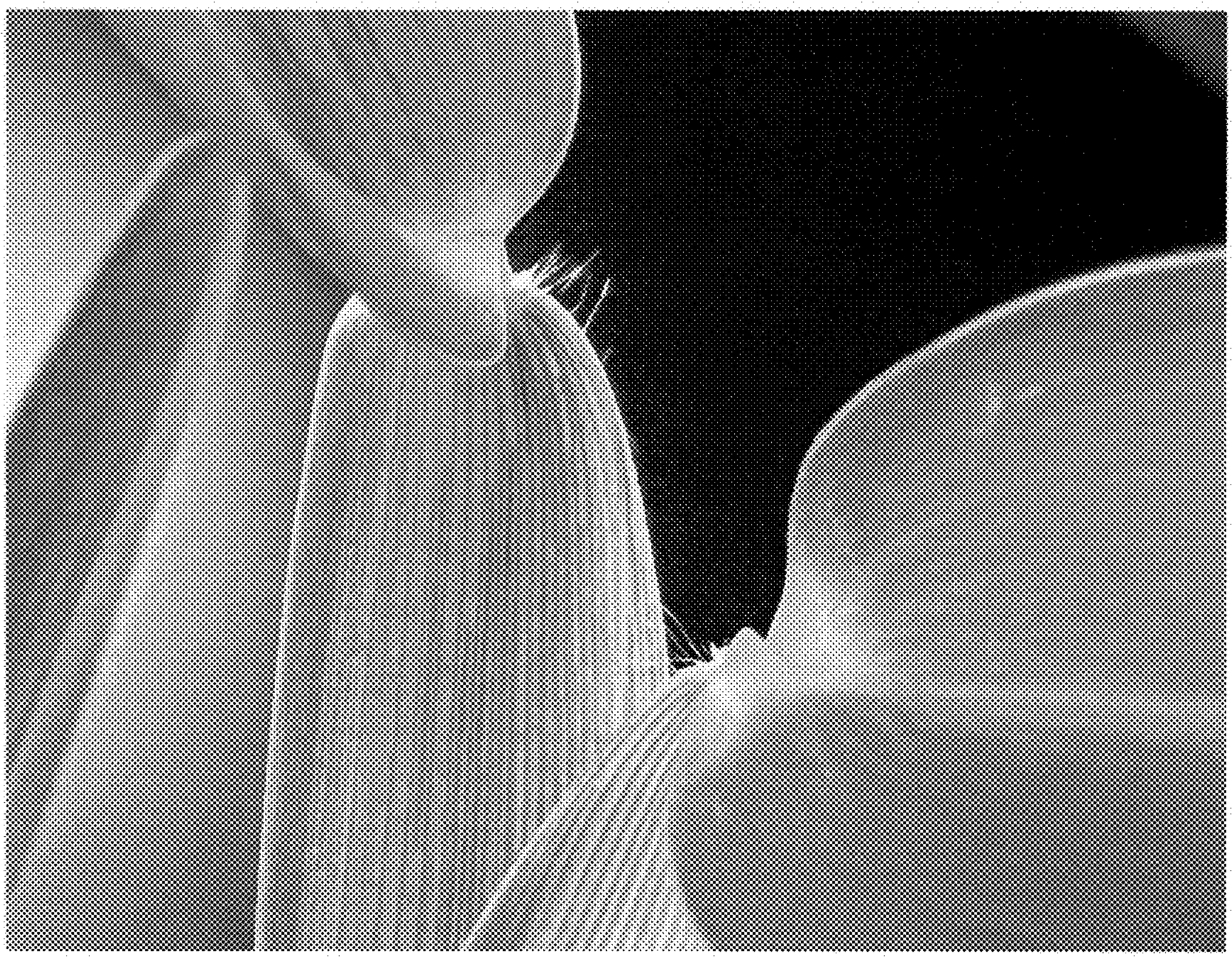


FIG. 5A

FIG. 5B

FIG. 6A

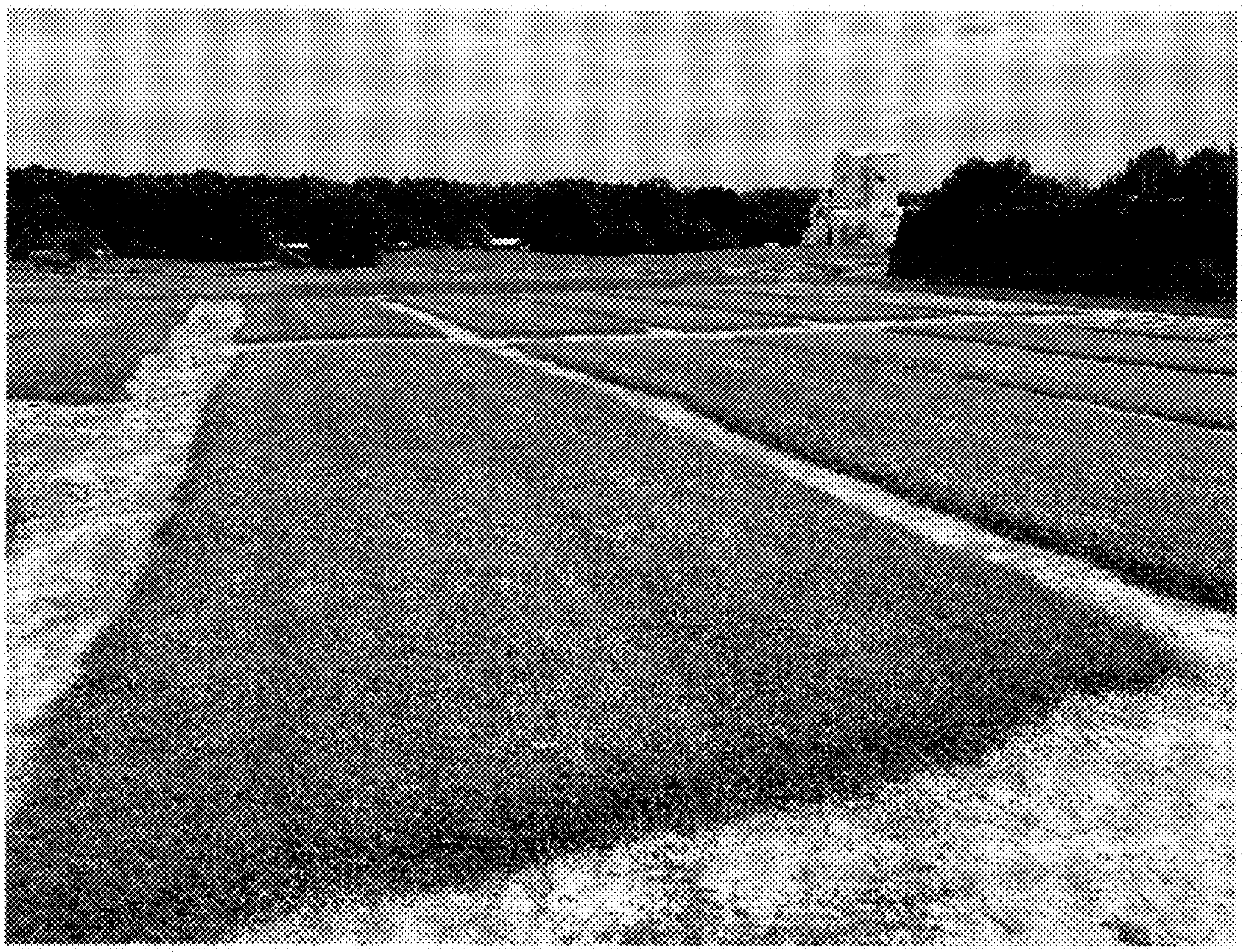


FIG. 6B

FIG. 6C

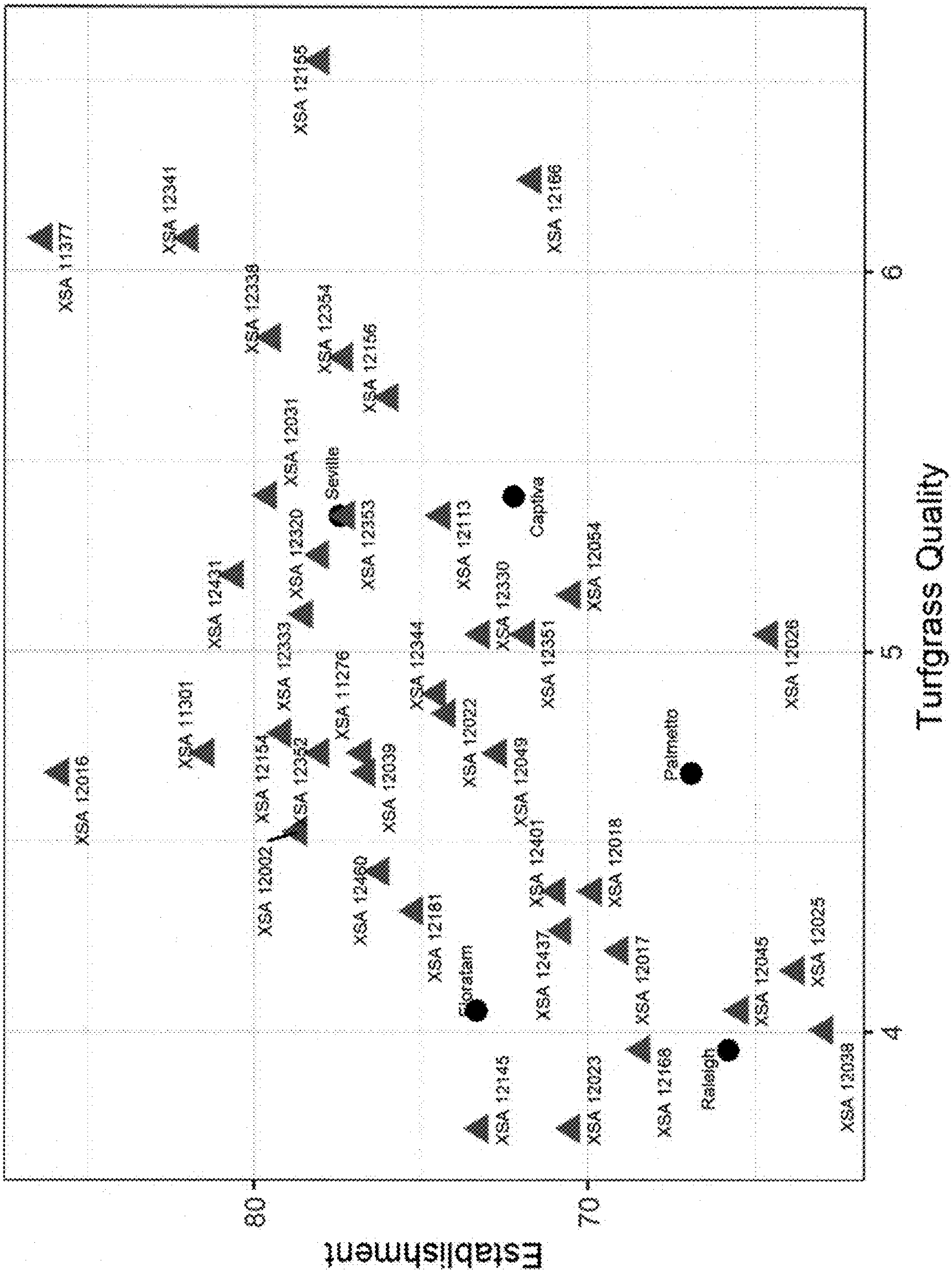

Establishment
Turfgrass Quality
80
70
4
5
6
XSA 11377
XSA 12341
XSA 12155
XSA 12166
XSA 12338
XSA 12354
XSA 12156
XSA 12031
Seville
XSA 12353
Captiva
XSA 12113
XSA 13320
XSA 12421
XSA 12054
XSA 12330
XSA 12351
XSA 12026
XSA 12333
XSA 11301
XSA 12016
XSA 11276
XSA 12344
XSA 12022
XSA 12154
XSA 12039
XSA 12049
Palmetto
XSA 12002
XSA 12401
XSA 12018
XSA 12460
XSA 12161
XSA 12437
XSA 12017
XSA 12045
XSA 12025
Floratam
XSA 12145
XSA 12023
XSA 12168
Raleigh
XSA 12038

FIG. 7A

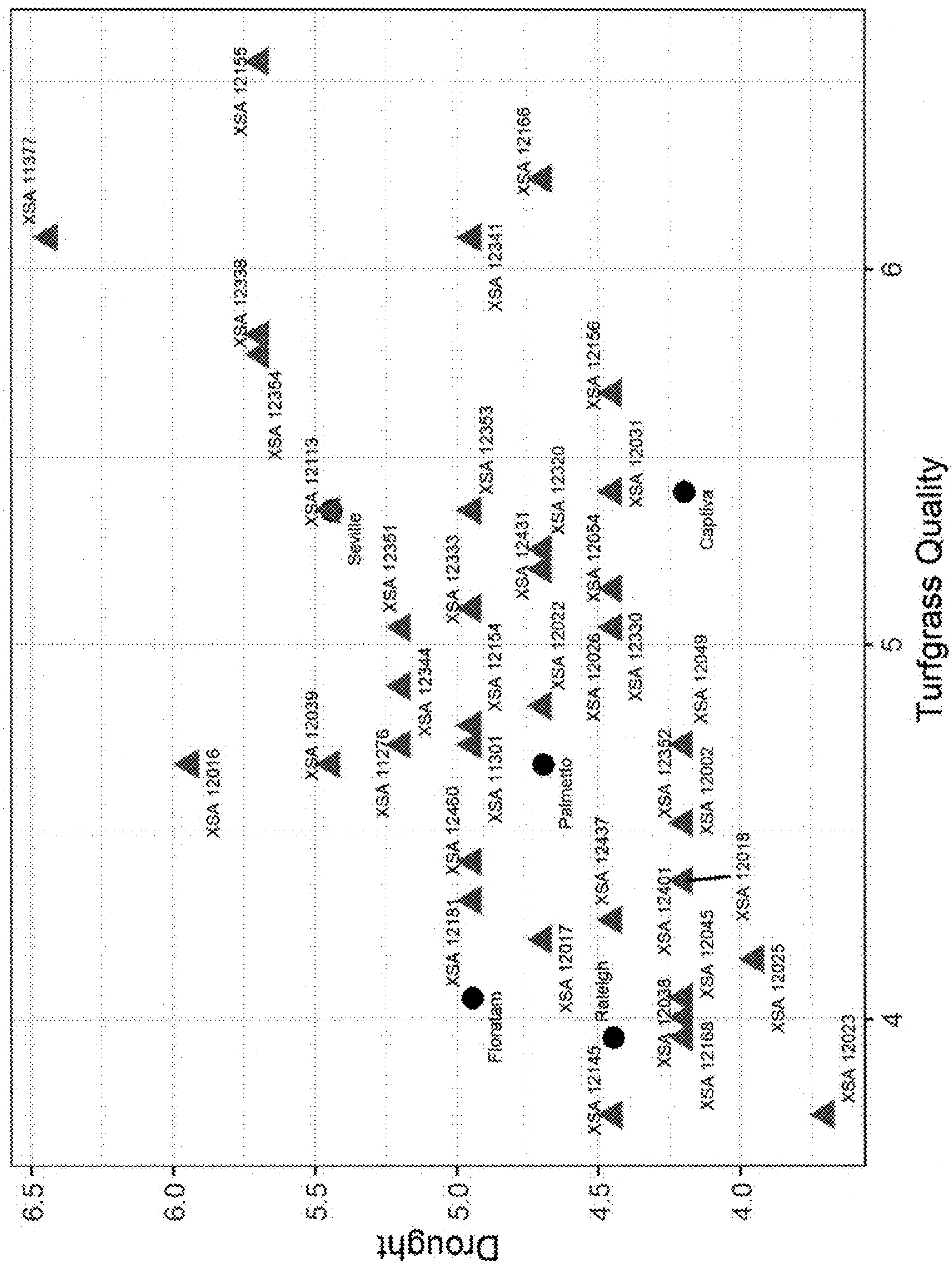
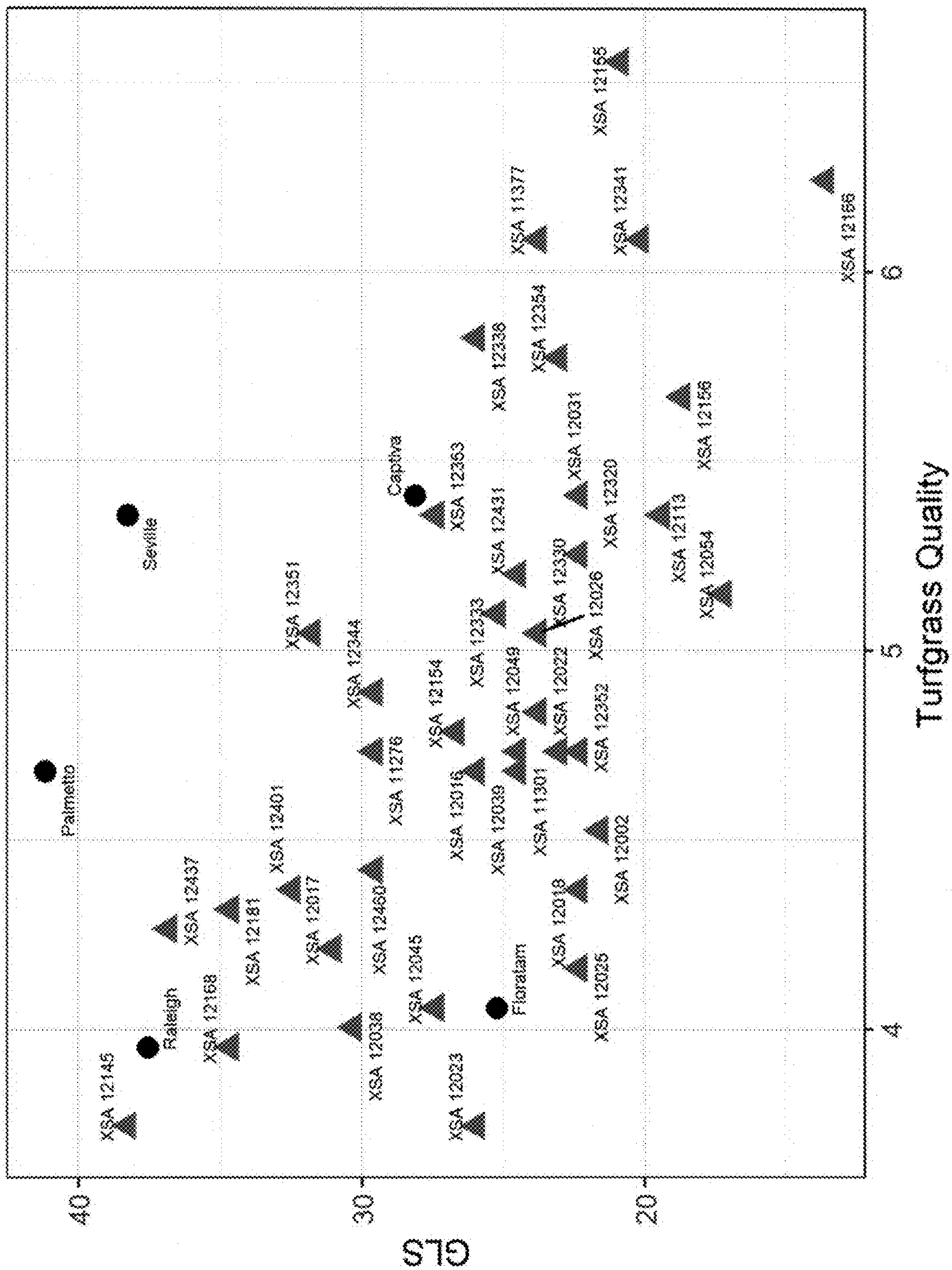

Drought
Turfgrass Quality
6.5
6.0
5.5
5.0
4.5
4.0
4
5
6
XSA 11377
XSA 12155
XSA 12166
XSA 12338
XSA 12354
XSA 12341
XSA 12156
XSA 12353
XSA 12113
Seville
XSA 12031
Capitiva
XSA 12320
XSA 12431
XSA 12351
XSA 12054
XSA 12333
XSA 12330
XSA 12022
XSA 12026
XSA 12049
XSA 12154
XSA 12344
XSA 12039
XSA 11276
XSA 11301
XSA 12016
Palmetto
XSA 12352
XSA 12002
XSA 12460
XSA 12437
XSA 12018
XSA 12401
XSA 12181
XSA 12017
XSA 12045
XSA 12025
Raleigh
XSA 12038
Floratam
XSA 12145
XSA 12185
XSA 12023

FIG. 7B

FIG. 7C


GLS
Turfgrass Quality
40
30
20
4
5
6
Raleigh
Palmetto
Seville
Captiva
Floratam
XSA 12145
XSA 12168
XSA 12437
XSA 12181
XSA 13401
XSA 12017
XSA 12351
XSA 12460
XSA 12038
XSA 12045
XSA 12023
XSA 12344
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XSA 12016
XSA 12039
XSA 12049
XSA 11301
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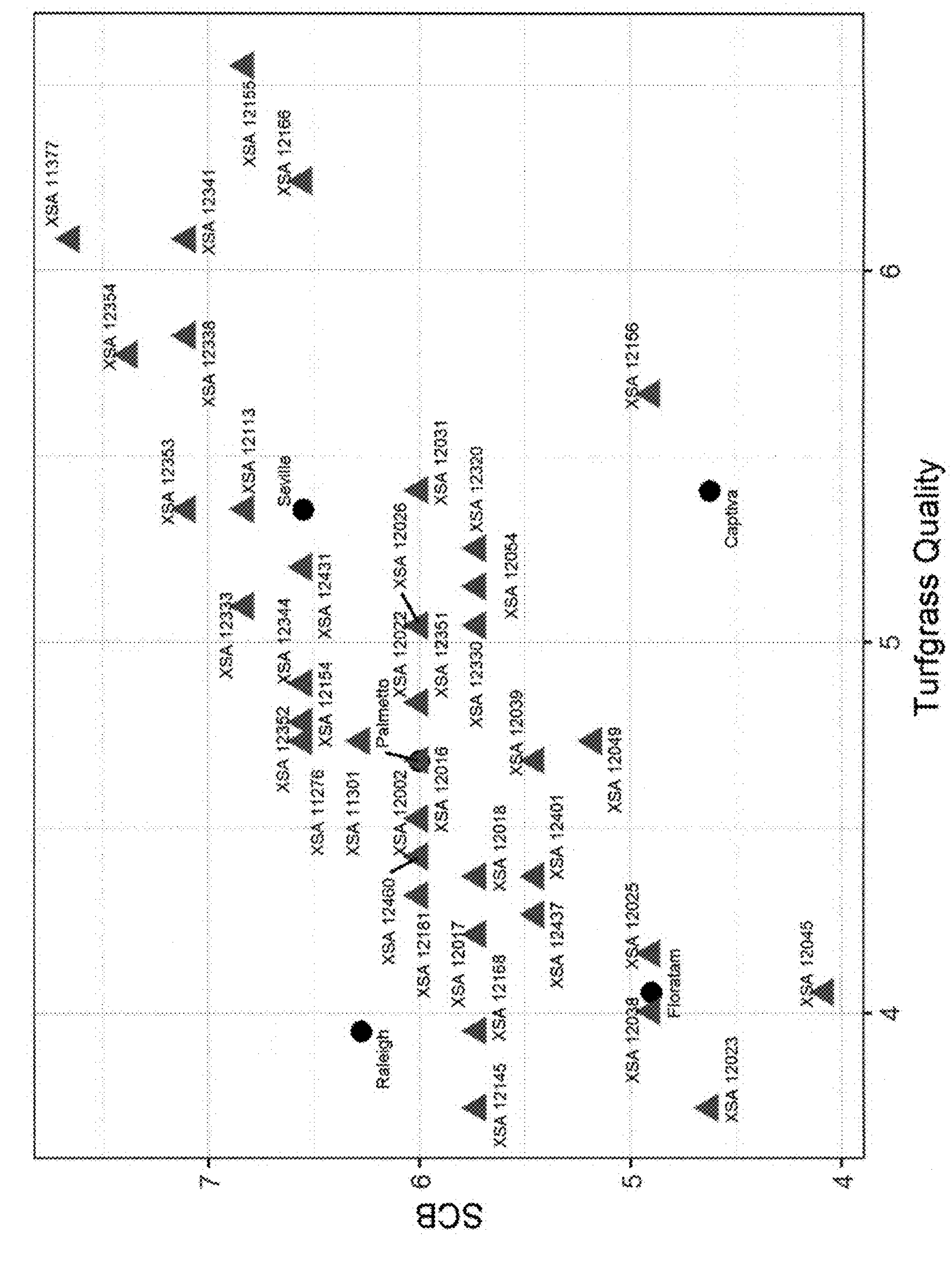
XSA 12320
XSA 12031
XSA 12113
XSA 12054
XSA 12338
XSA 12354
XSA 12156
XSA 11377
XSA 12341
XSA 12166
XSA 12155

FIG. 7D


SCB
Turfgrass Quality
7
6
5
4
4
5
6
XSA 11377
XSA 12155
XSA 12166
XSA 12341
XSA 12354
XSA 12338
XSA 12156
XSA 12353
XSA 12113
Seville
XSA 12031
XSA 12330
XSA 12026
Captiva
XSA 12054
XSA 12431
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XSA 12344
XSA 12022
XSA 12351
XSA 12330
XSA 12154
Palmetto
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XSA 12401
XSA 12460
XSA 12161
XSA 12017
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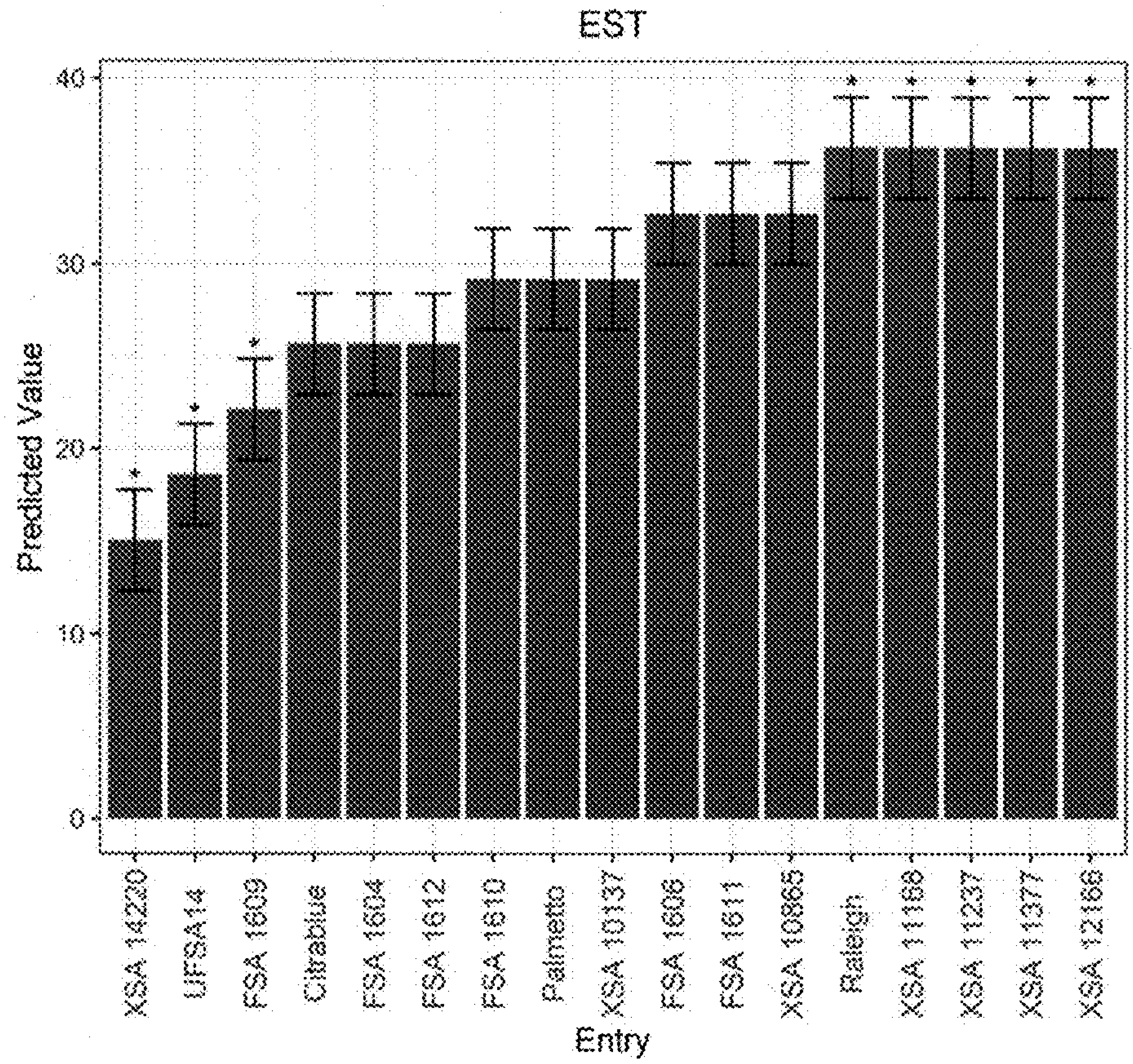
XSA 12437
XSA 12168
Floratam
XSA 12045
XSA 12038
Raleigh
XSA 12145
XSA 12023

FIG. 8


EST
Predicted Value
0
10
20
30
40
XSA 14220
UFSA14
FSA 1609
Citrablue
FSA 1604
FSA 1612
FSA 1610
Palmetto
XSA 10137
FSA 1606
FSA 1611
XSA 10865
Raleigh
XSA 11168
XSA 11237
XSA 11377
XSA 12166
Entry

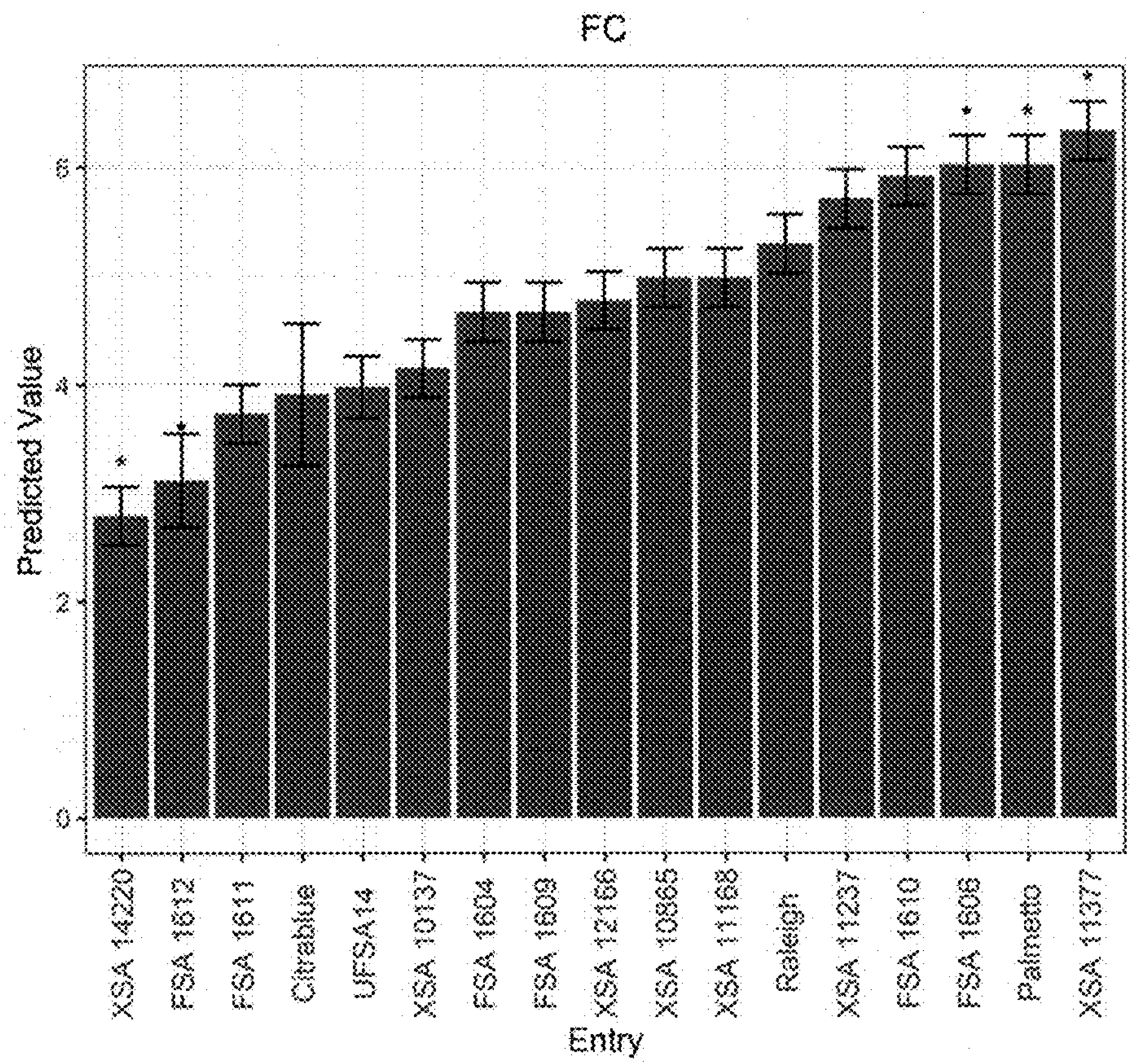
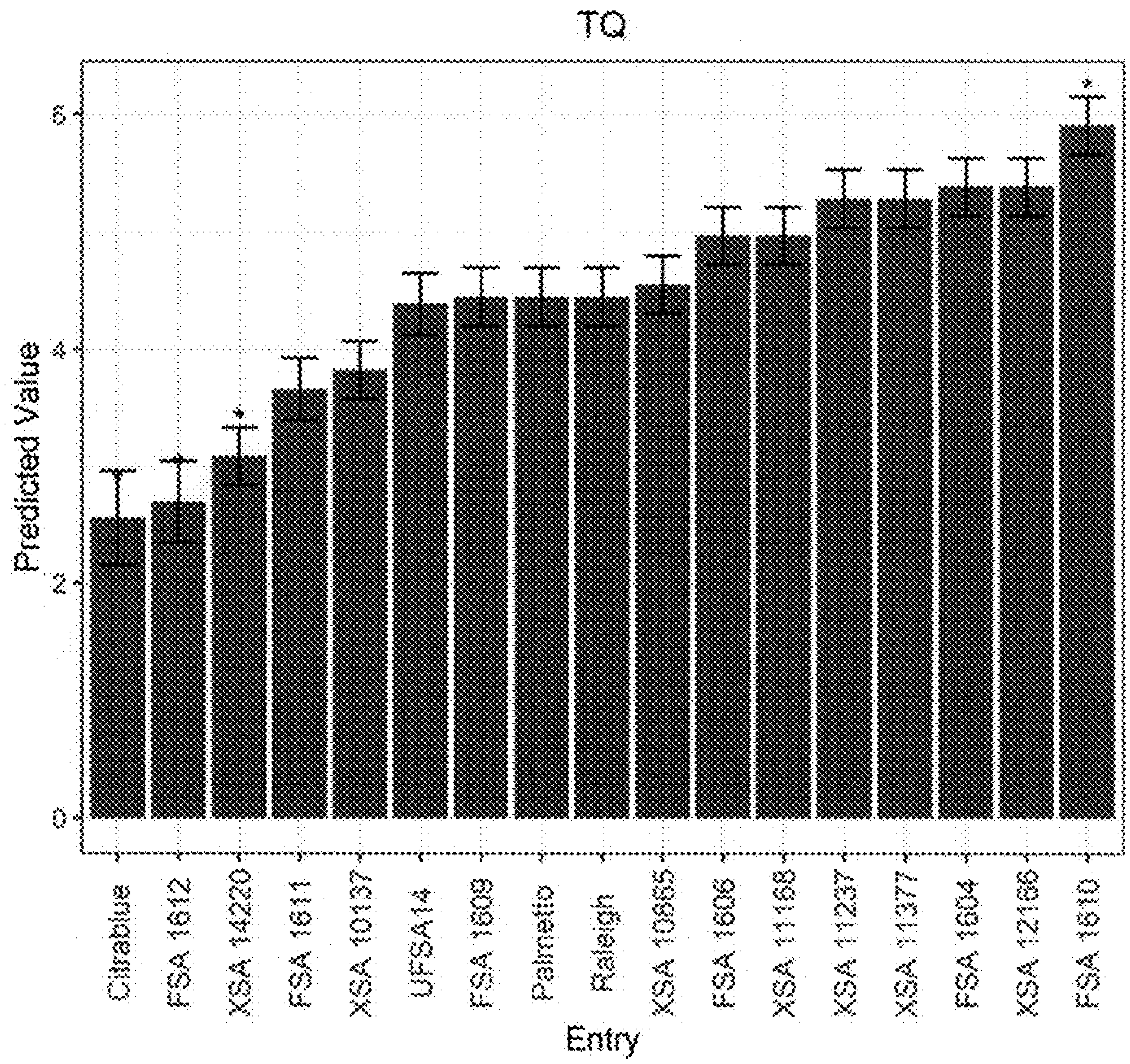

FC
Predicted Value
0
2
4
6
XSA 14220
FSA 1612
FSA 1611
Citrablue
UFSA14
XSA 10137
FSA 1604
FSA 1609
XSA 12166
XSA 10865
XSA 11168
Raleigh
XSA 11237
FSA 1610
FSA 1606
Palmetto
XSA 11377
Entry

FIG. 8 (cont.)


TQ
Predicted Value
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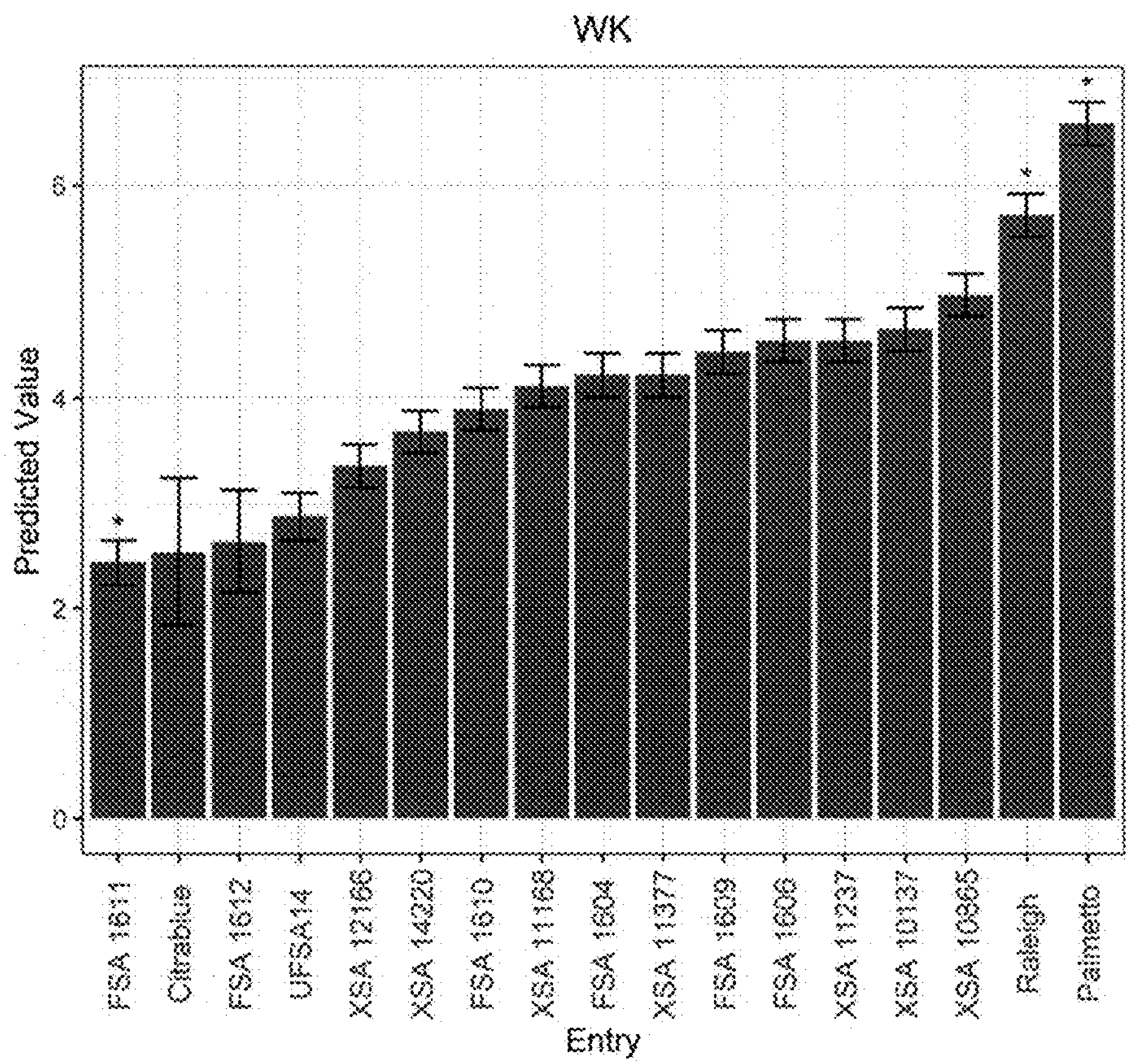
2
4
6
Citrablue
FSA 1612
XSA 14220
FSA 1611
XSA 10137
UFSA14
FSA 1609
Palmetto
Raleigh
XSA 10865
FSA 1606
XSA 11168
XSA 11237
XSA 11377
FSA 1604
XSA 12166
FSA 1610
Entry


WK
Predicted Value
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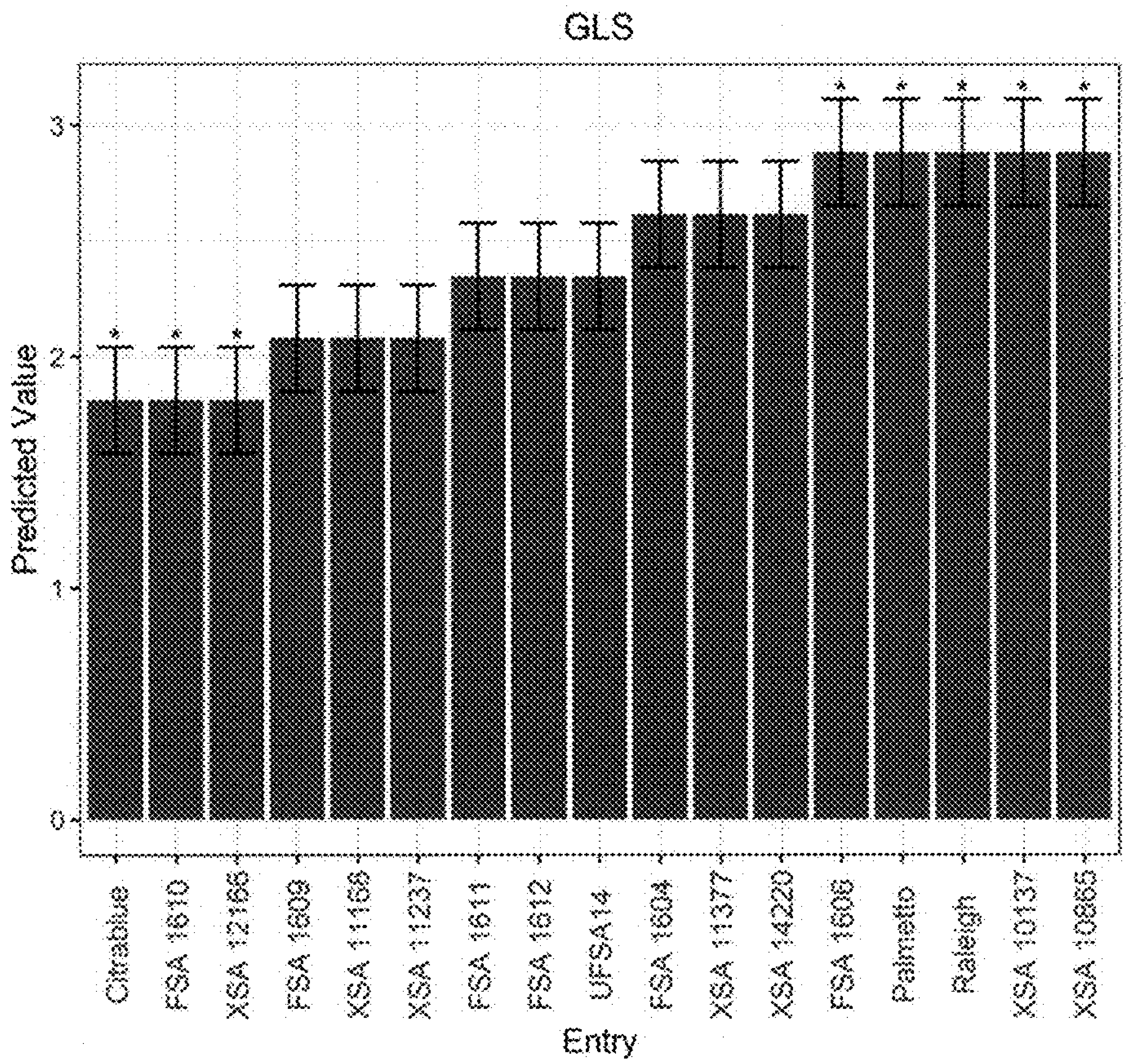
2
4
6
FSA 1611
Citrablue
FSA 1612
UFSA14
XSA 12166
XSA 14220
FSA 1610
XSA 11168
FSA 1604
XSA 11377
FSA 1609
FSA 1606
XSA 11237
XSA 10137
XSA 10865
Raleigh
Palmetto
Entry

FIG. 8 (cont.)


GLS
Predicted Value
0
1
2
3
Citrablue
FSA 1610
XSA 12166
FSA 1609
XSA 11168
XSA 11237
FSA 1611
FSA 1612
UFSA14
FSA 1604
XSA 11377
XSA 14220
FSA 1606
Palmetto
Raleigh
XSA 10137
XSA 10865
Entry

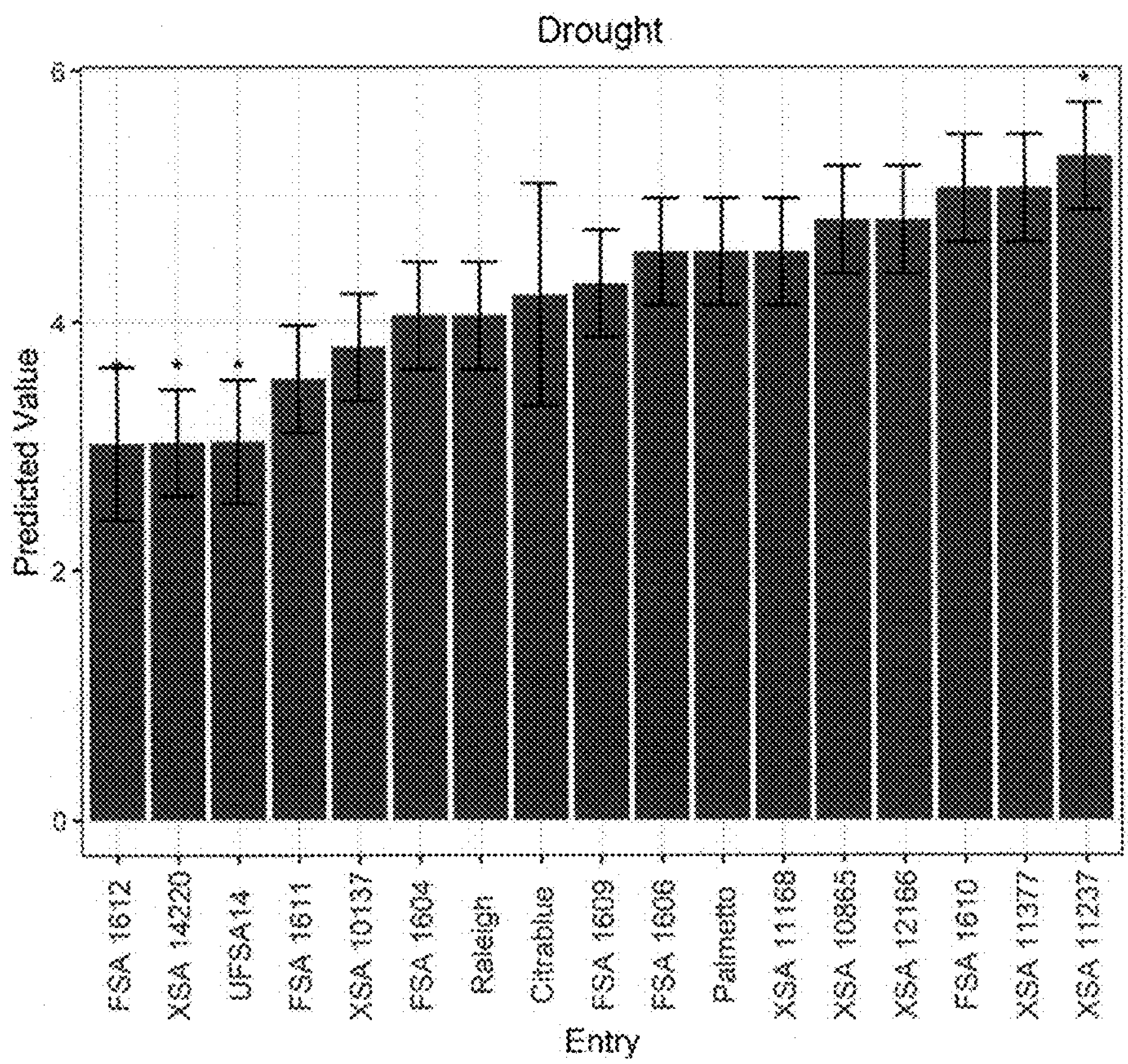

Drought
Predicted Value
0
2
4
6
FSA 1612
XSA 14220
UFSA14
FSA 1611
XSA 10137
FSA 1604
Raleigh
Citrablue
FSA 1609
FSA 1606
Palmetto
XSA 11168
XSA 10865
XSA 12166
FSA 1610
XSA 11377
XSA 11237
Entry

FIG. 9

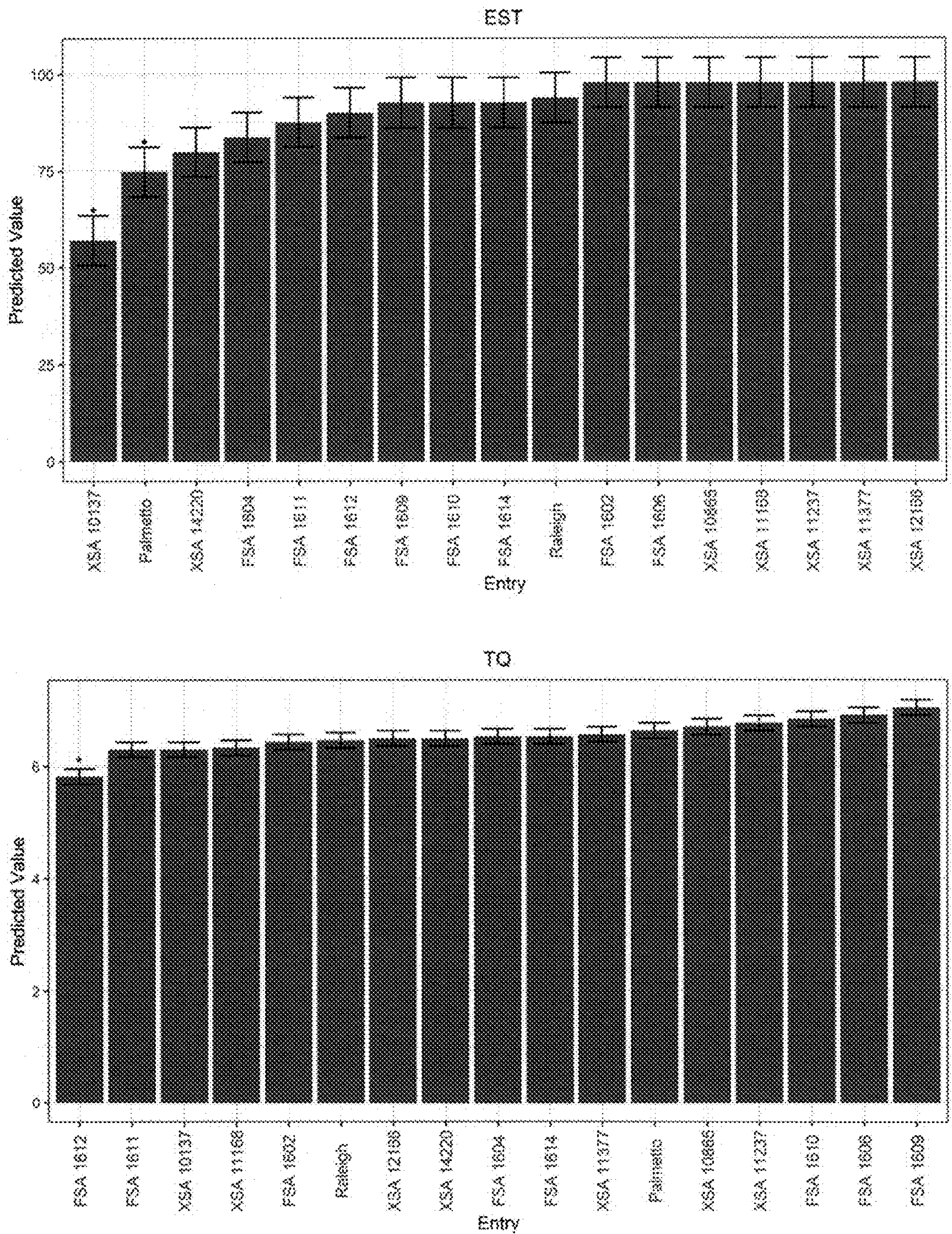

EST
Predicted Value
100
75
50
25
0
XSA 10137
Palmetto
XSA 14220
FSA 1604
FSA 1611
FSA 1612
FSA 1609
FSA 1610
FSA 1614
Raleigh
FSA 1602
FSA 1606
XSA 10866
XSA 11168
XSA 11237
XSA 11377
XSA 12156
Entry
TQ
Predicted Value
6
4
2
0
FSA 1612
FSA 1611
XSA 10137
XSA 11168
FSA 1602
Raleigh
XSA 12156
XSA 14220
FSA 1604
FSA 1614
XSA 11377
Palmetto
XSA 10866
XSA 11237
FSA 1610
FSA 1606
FSA 1609
Entry

FIG. 9 (cont.)

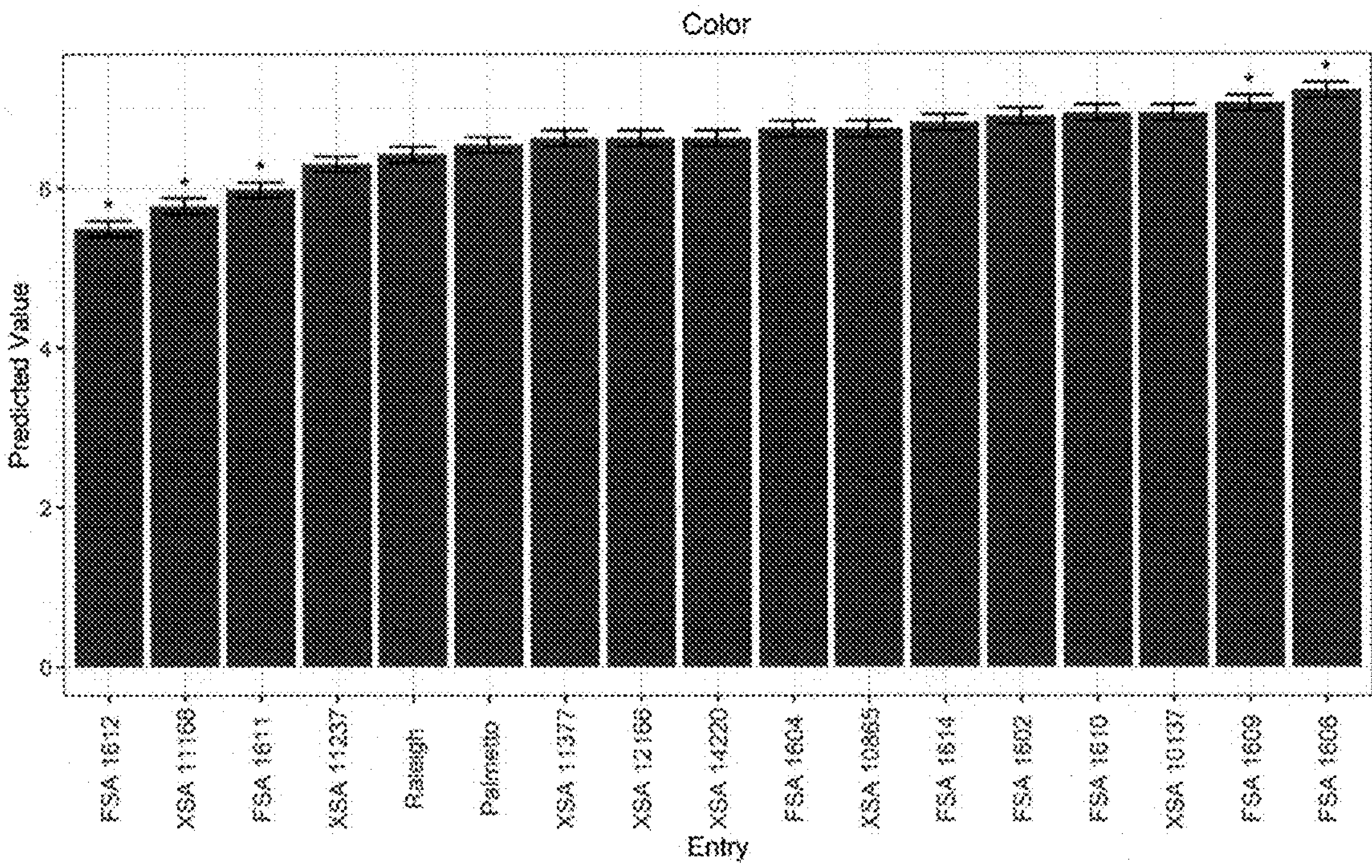

Color
Predicted Value
0
2
4
6
Entry
FSA 1612
XSA 11168
FSA 1611
XSA 11237
Raleigh
Palmetto
XSA 11377
XSA 12166
XSA 14220
FSA 1604
XSA 10865
FSA 1614
FSA 1602
FSA 1610
XSA 10137
FSA 1609
FSA 1606

FIG. 10

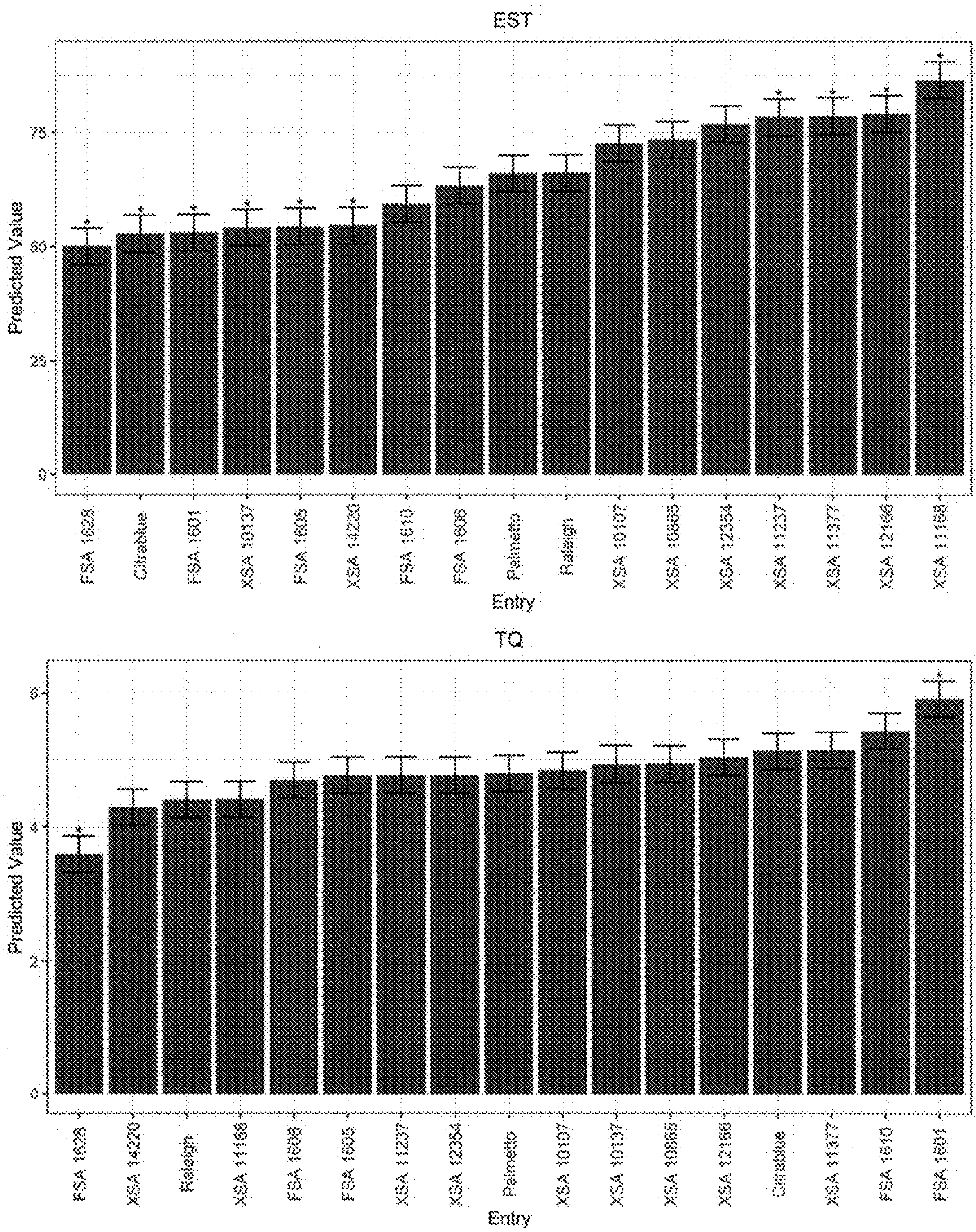

EST
Predicted Value
75
50
25
0
FSA 1628
Citrablue
FSA 1601
XSA 10137
FSA 1605
XSA 14220
FSA 1610
FSA 1606
Palmetto
Raleigh
XSA 10107
XSA 10865
XSA 12354
XSA 11237
XSA 11377
XSA 12156
XSA 11168
Entry
TQ
Predicted Value
6
4
2
0
FSA 1628
XSA 14220
Raleigh
XSA 11168
FSA 1606
FSA 1605
XSA 11237
XSA 12354
Palmetto
XSA 10107
XSA 10137
XSA 10865
XSA 12156
Citrablue
XSA 11377
FSA 1610
FSA 1601
Entry

FIG. 10 (cont.)

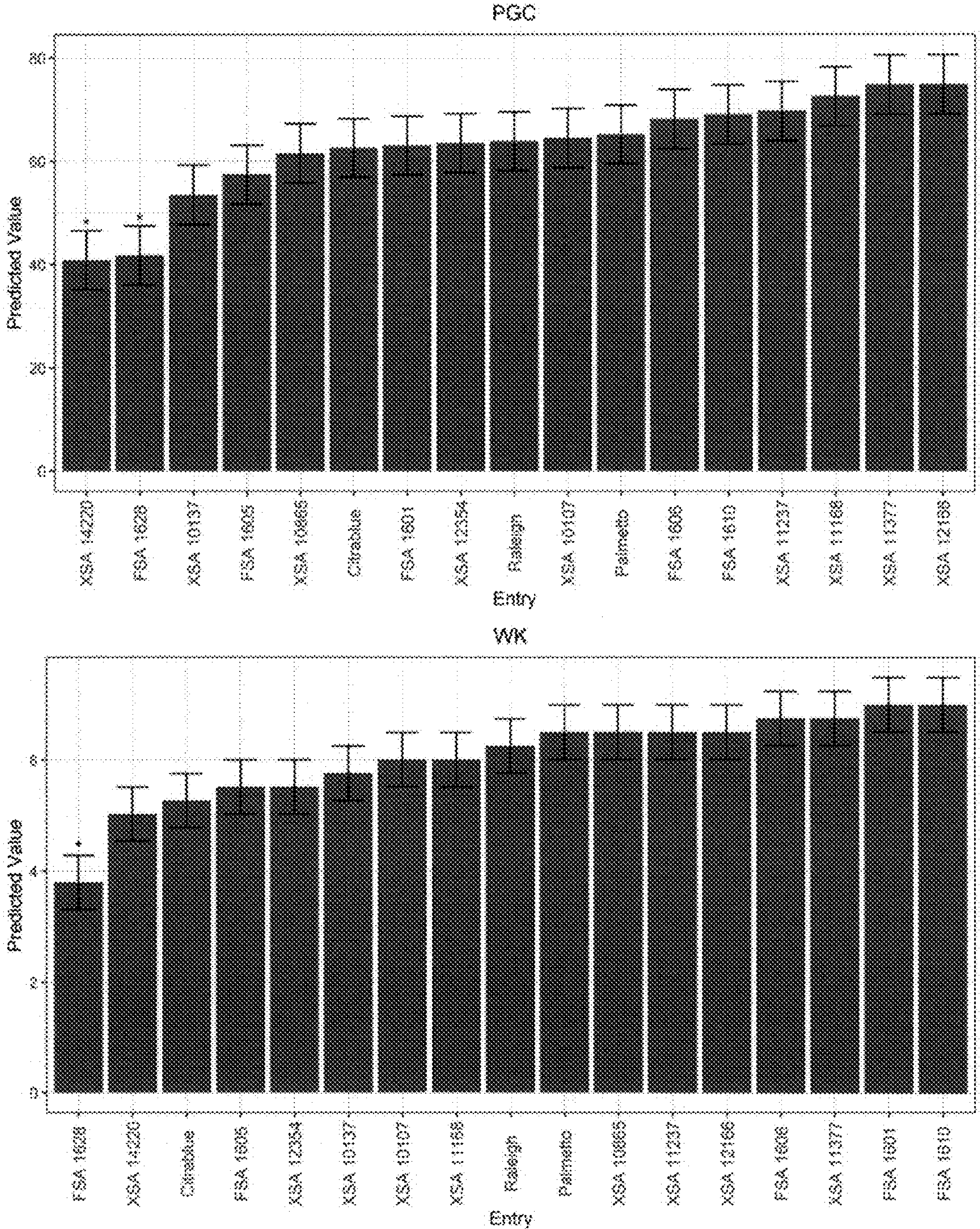
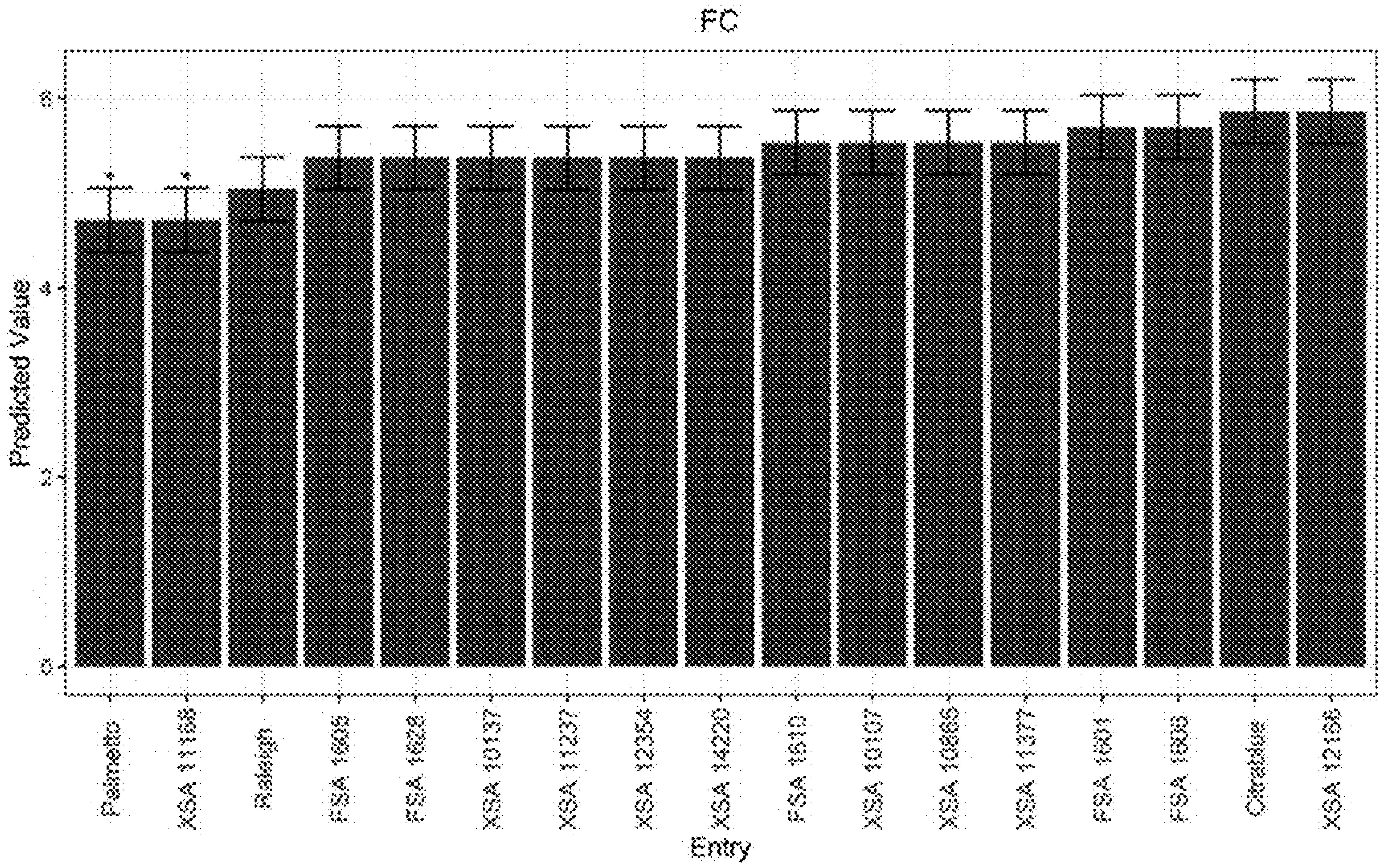

PGC
Predicted Value
0
20
40
60
80
XSA 14220
FSA 1628
XSA 10137
FSA 1605
XSA 10865
Citrablue
FSA 1601
XSA 12354
Raleigh
XSA 10107
Palmetto
FSA 1606
FSA 1610
XSA 11237
XSA 11168
XSA 11377
XSA 12166
Entry
WK
Predicted Value
0
2
4
6
FSA 1628
XSA 14220
Citrablue
FSA 1605
XSA 12354
XSA 10137
XSA 10107
XSA 11168
Raleigh
Palmetto
XSA 10865
XSA 11237
XSA 12166
FSA 1606
XSA 11377
FSA 1601
FSA 1610
Entry

FIG. 10 (cont.)


FC
Predicted Value
Entry
Palmetto
XSA 11168
Raleigh
FSA 1605
FSA 1628
XSA 10137
XSA 11237
XSA 12354
XSA 14220
FSA 1610
XSA 10107
XSA 10865
XSA 11377
FSA 1601
FSA 1606
Citrablue
XSA 12166

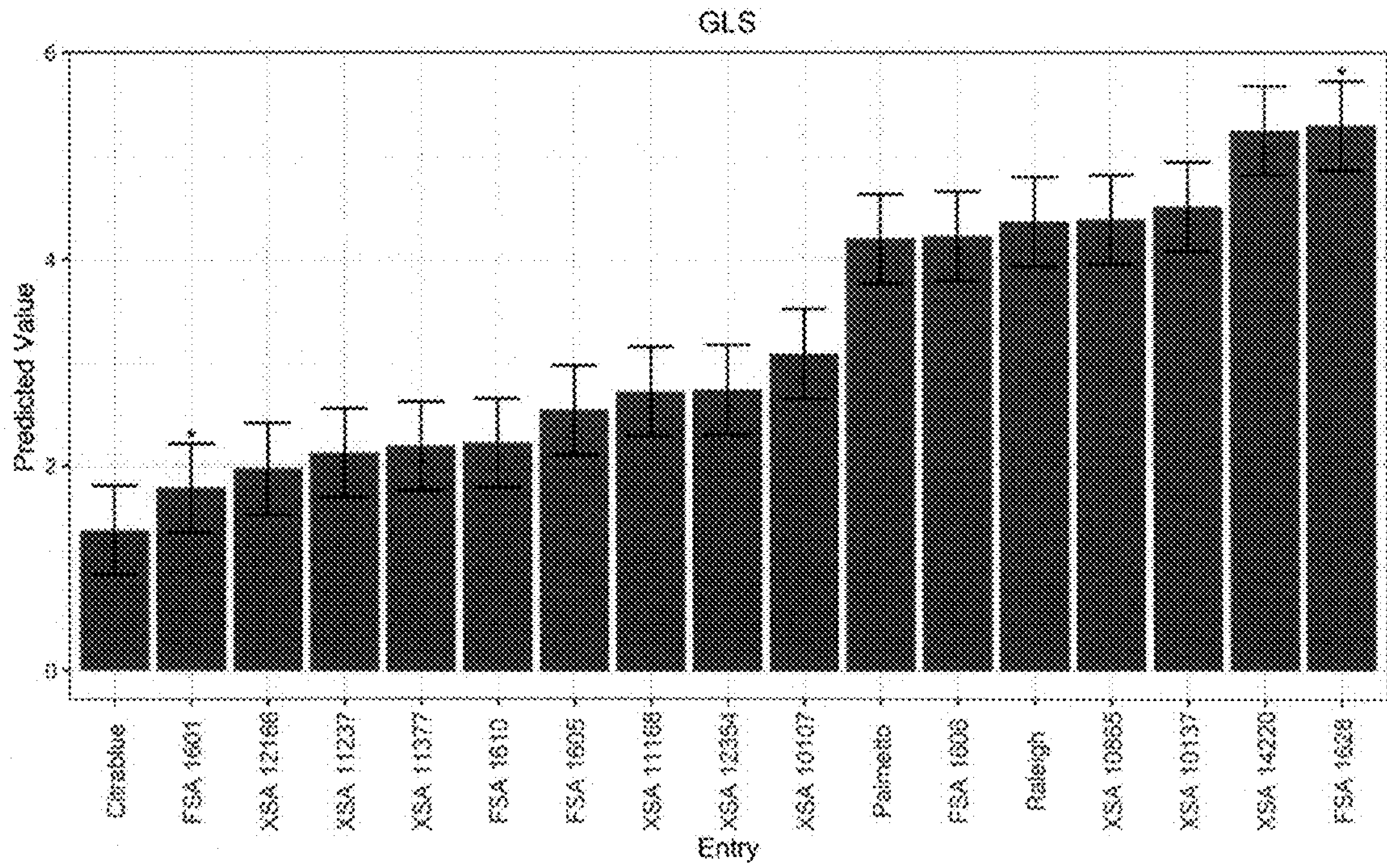

GLS
Predicted Value
Entry
Citrablue
FSA 1601
XSA 12166
XSA 11237
XSA 11377
FSA 1610
FSA 1605
XSA 11168
XSA 12354
XSA 10107
Palmetto
FSA 1606
Raleigh
XSA 10865
XSA 10137
XSA 14220
FSA 1628

FIG. 10 (cont.)

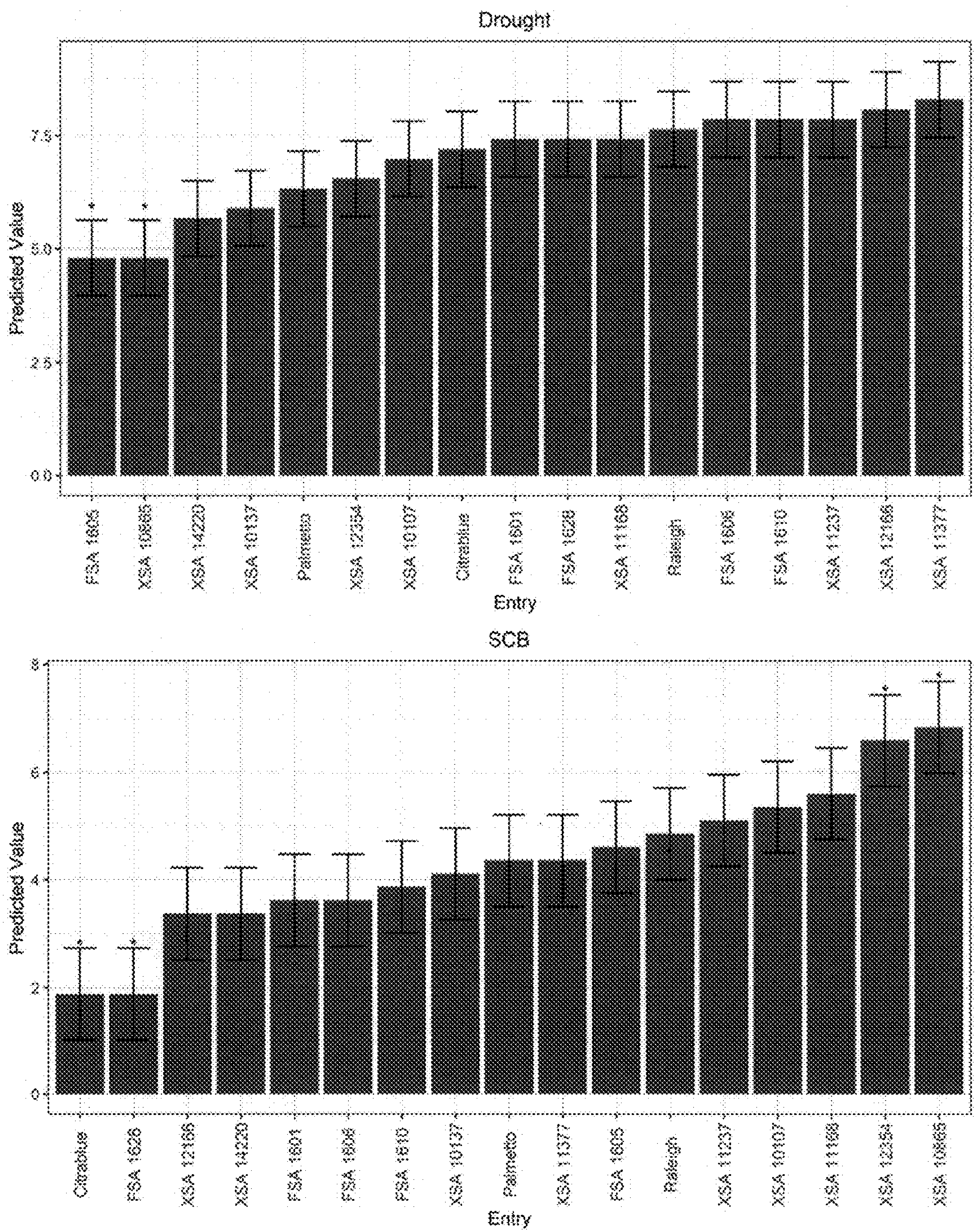

Drought
Predicted Value
0.0
2.5
5.0
7.5
FSA 1605
XSA 10865
XSA 14220
XSA 10137
Palmetto
XSA 12354
XSA 10107
Citrablue
FSA 1601
FSA 1626
XSA 11168
Raleigh
FSA 1606
FSA 1610
XSA 11237
XSA 12166
XSA 11377
Entry
SCB
Predicted Value
0
2
4
6
8
Citrablue
FSA 1626
XSA 12166
XSA 14220
FSA 1601
FSA 1606
FSA 1610
XSA 10137
Palmetto
XSA 11377
FSA 1605
Raleigh
XSA 11237
XSA 10107
XSA 11168
XSA 12354
XSA 10865
Entry

FIG. 11

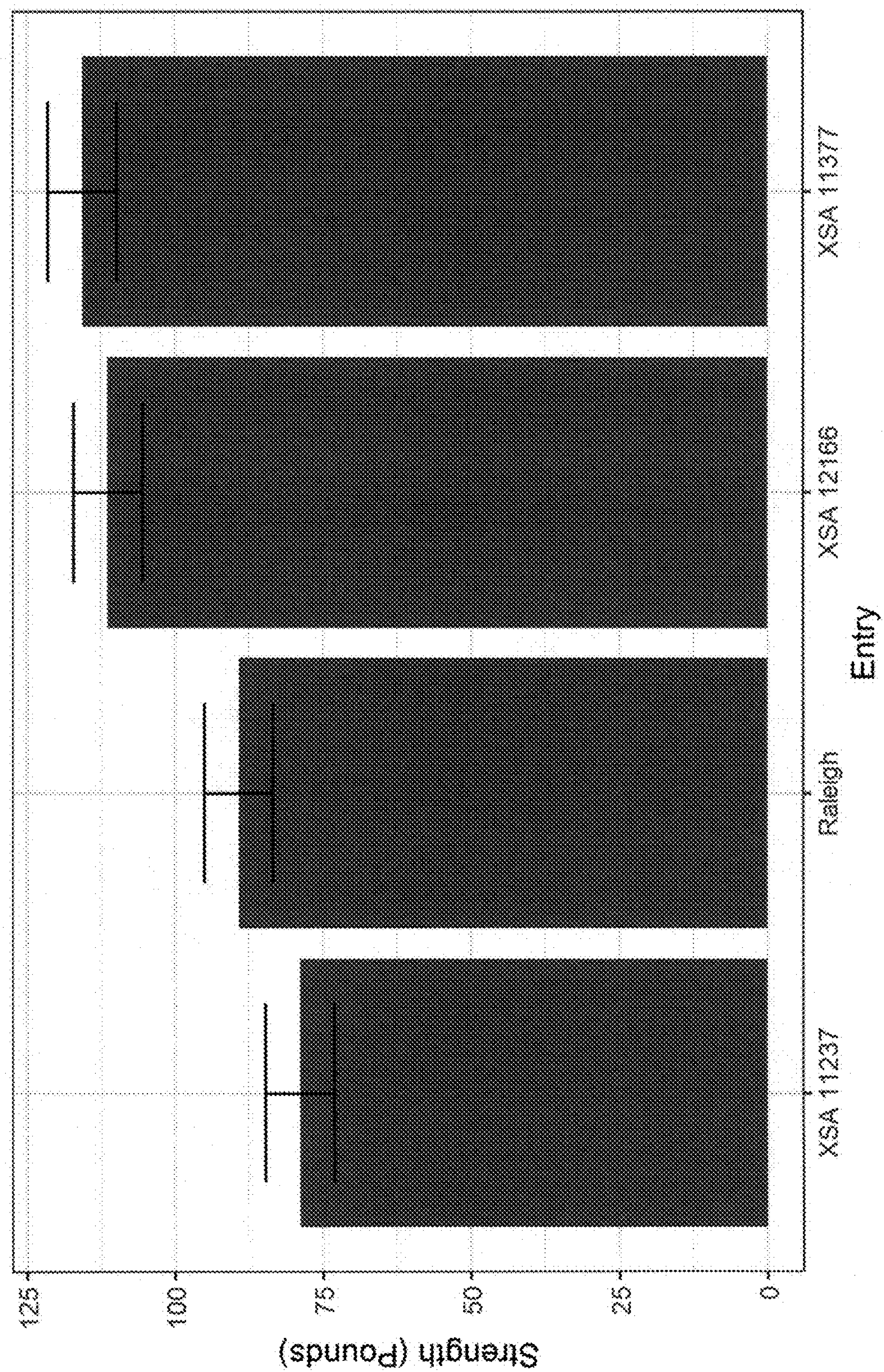
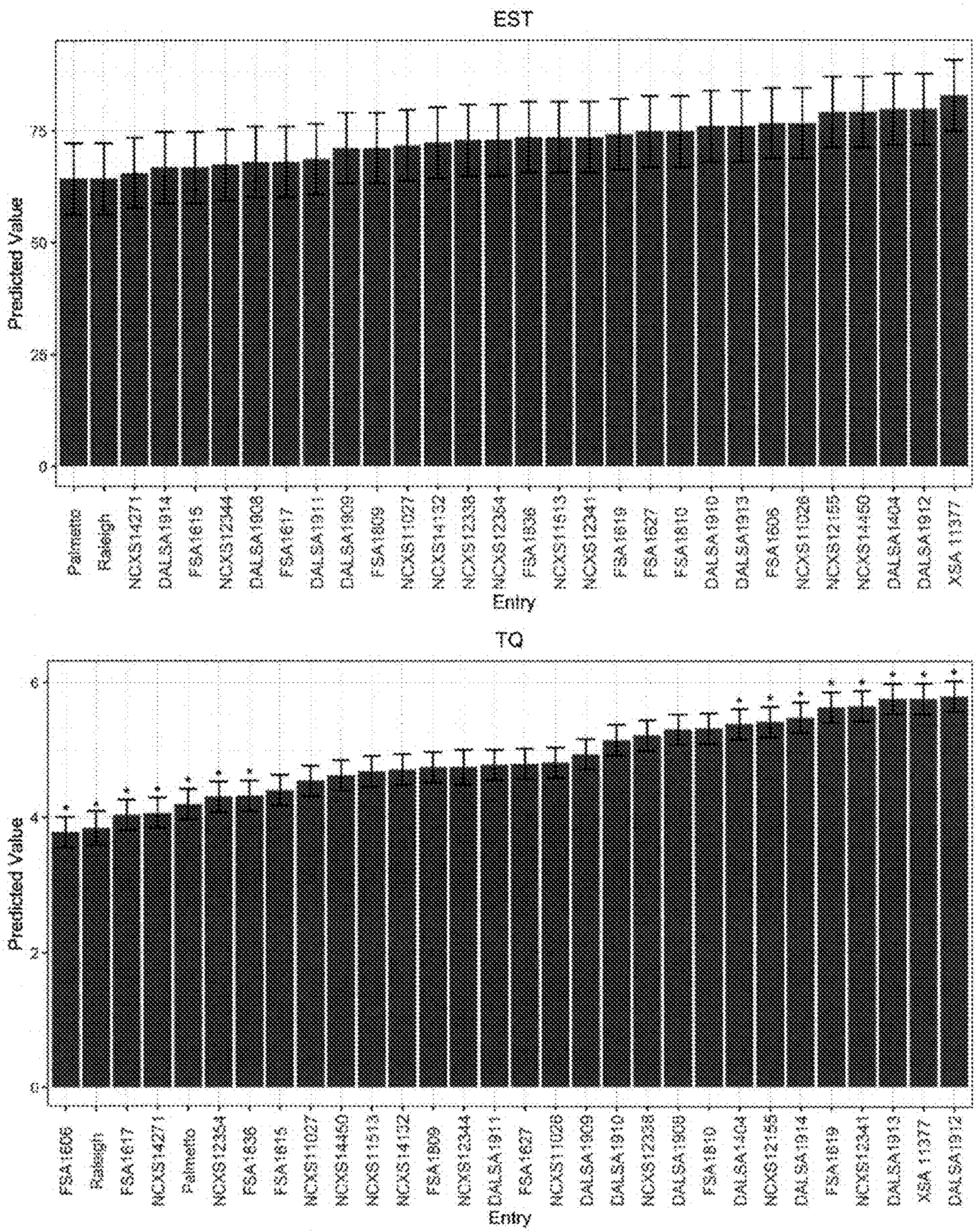
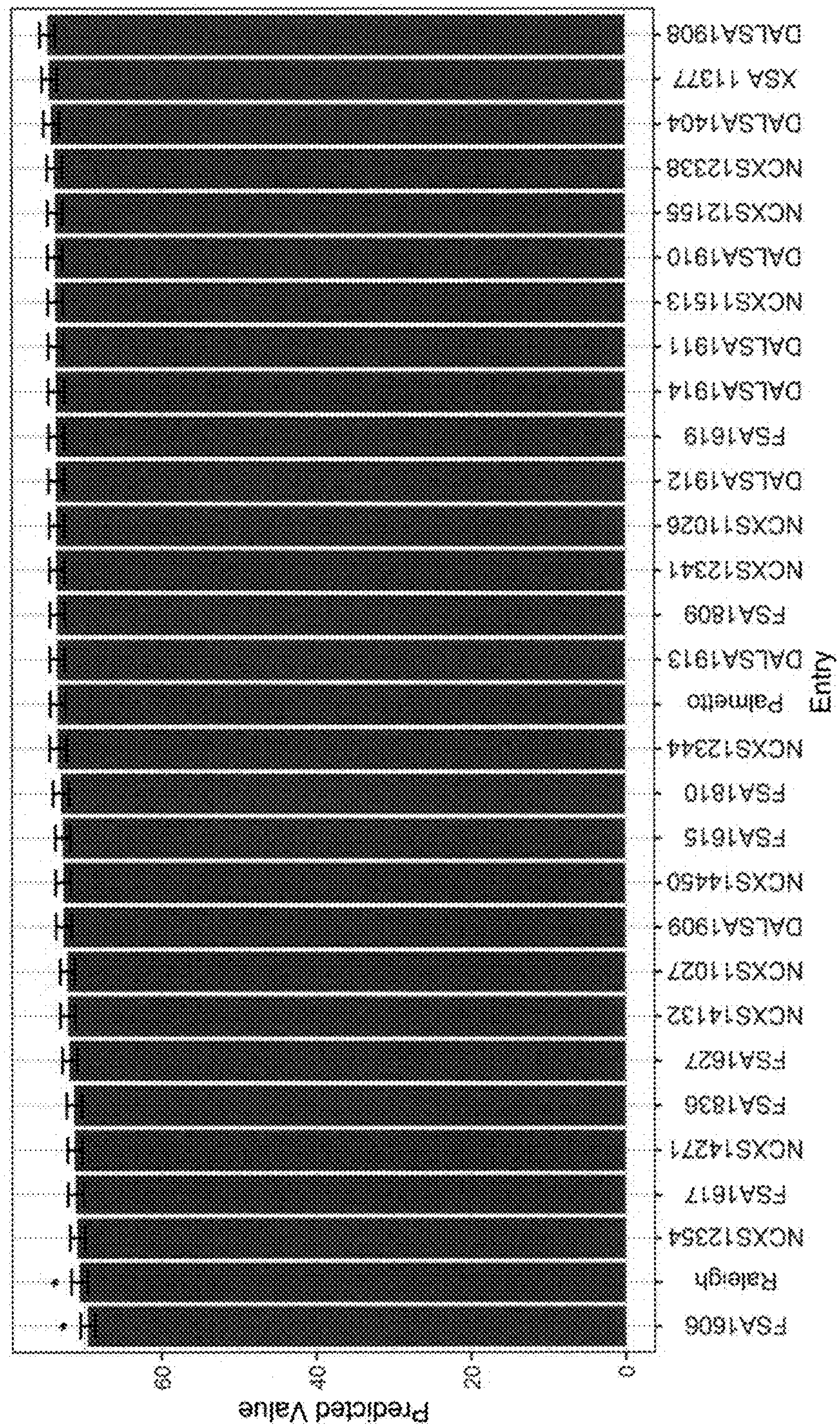

Strength (Pounds)
0
25
50
75
100
125
Entry
XSA 11237
Raleigh
XSA 12166
XSA 11377

FIG. 12

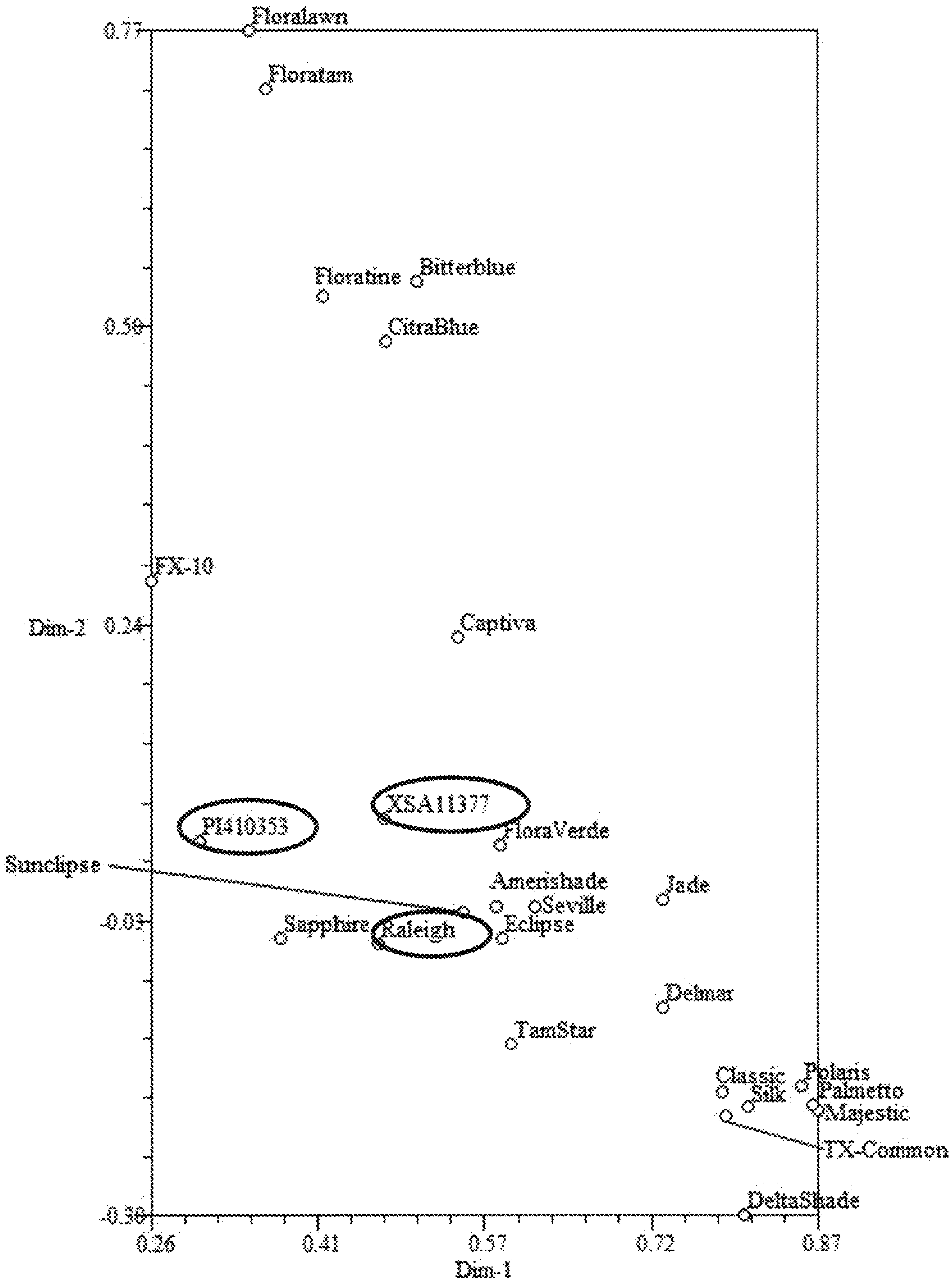

EST
Predicted Value
75
50
25
0
Palmetto
Raleigh
NCXS14271
DALSA1914
FSA1615
NCXS12344
DALSA1908
FSA1617
DALSA1911
DALSA1909
FSA1809
NCXS11027
NCXS14132
NCXS12338
NCXS12354
FSA1836
NCXS11513
NCXS12341
FSA1819
FSA1627
FSA1810
DALSA1910
DALSA1913
FSA1606
NCXS11028
NCXS12155
NCXS14450
DALSA1404
DALSA1912
XSA 11377
Entry
TQ
Predicted Value
6
4
2
0
FSA1606
Raleigh
FSA1617
NCXS14271
Palmetto
NCXS12354
FSA1836
FSA1615
NCXS11027
NCXS14450
NCXS11513
NCXS14132
FSA1809
NCXS12344
DALSA1911
FSA1627
NCXS11028
DALSA1909
DALSA1910
NCXS12338
DALSA1908
FSA1810
DALSA1404
NCXS12155
DALSA1914
FSA1819
NCXS12341
DALSA1913
XSA 11377
DALSA1912
Entry



PGC
Predicted Value
0
20
40
60
Entry
FSA1606
Raleigh
NCXS12354
FSA1617
NCXS14271
FSA1836
FSA1627
NCXS14132
NCXS11027
DALSA1909
NCXS14450
FSA1615
FSA1810
NCXS12344
Palmetto
DALSA1913
FSA1809
NCXS12341
NCXS11026
DALSA1912
FSA1619
DALSA1914
DALSA1911
NCXS11513
DALSA1910
NCXS12155
NCXS12338
DALSA1404
XSA 11377
DALSA1908

FIG. 12 (cont.)

FIG. 13A



Floralawn
Floratam
Floratine
Bitterblue
CitraBlue
FX-10
Captiva
PI410353
XSA11377
FloraVerde
Sunclipse
Amerishade
Jade
Seville
Sapphire
Raleigh
Eclipse
Delmar
TamStar
Classic
Polaris
Silk
Palmetto
Majestic
TX-Common
DeltaShade
Dim-2
0.77
0.50
0.24
-0.03
-0.30
0.26
0.41
0.57
0.72
0.87
Dim-1

FIG. 13B

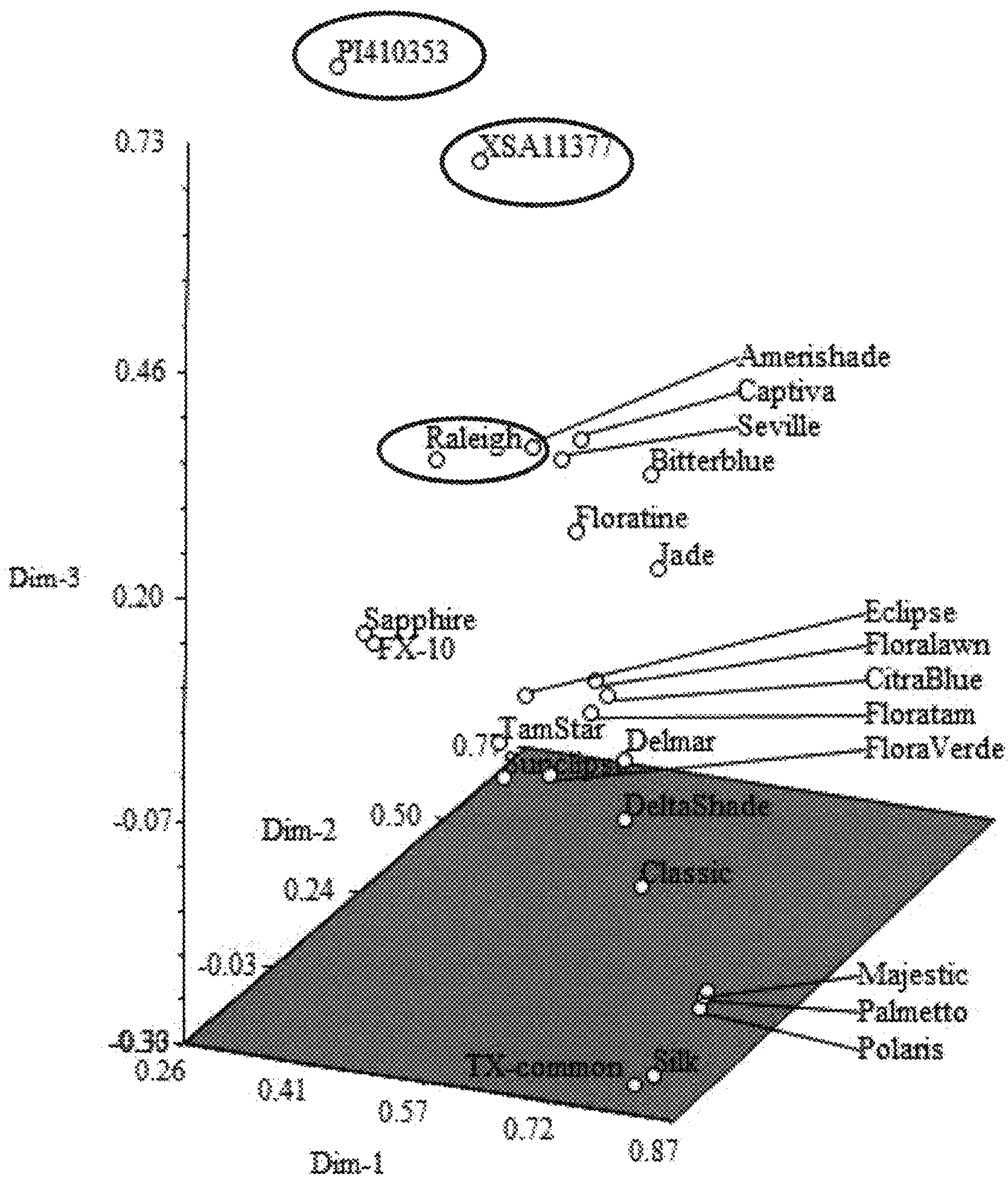

PI410353
XSA11377
Amerishade
Captiva
Seville
Raleigh
Bitterblue
Floratine
Jade
Sapphire
FX-10
Eclipse
Floralawn
CitraBlue
Floratam
TamStar
Delmar
FloraVerde
DeltaShade
Classic
Majestic
Palmetto
Polaris
TX-common
Silk
Dim-3
0.73
0.46
0.20
-0.07
-0.30
Dim-2
0.50
0.24
-0.03
Dim-1
0.26
0.41
0.57
0.72
0.87

FIG. 14A

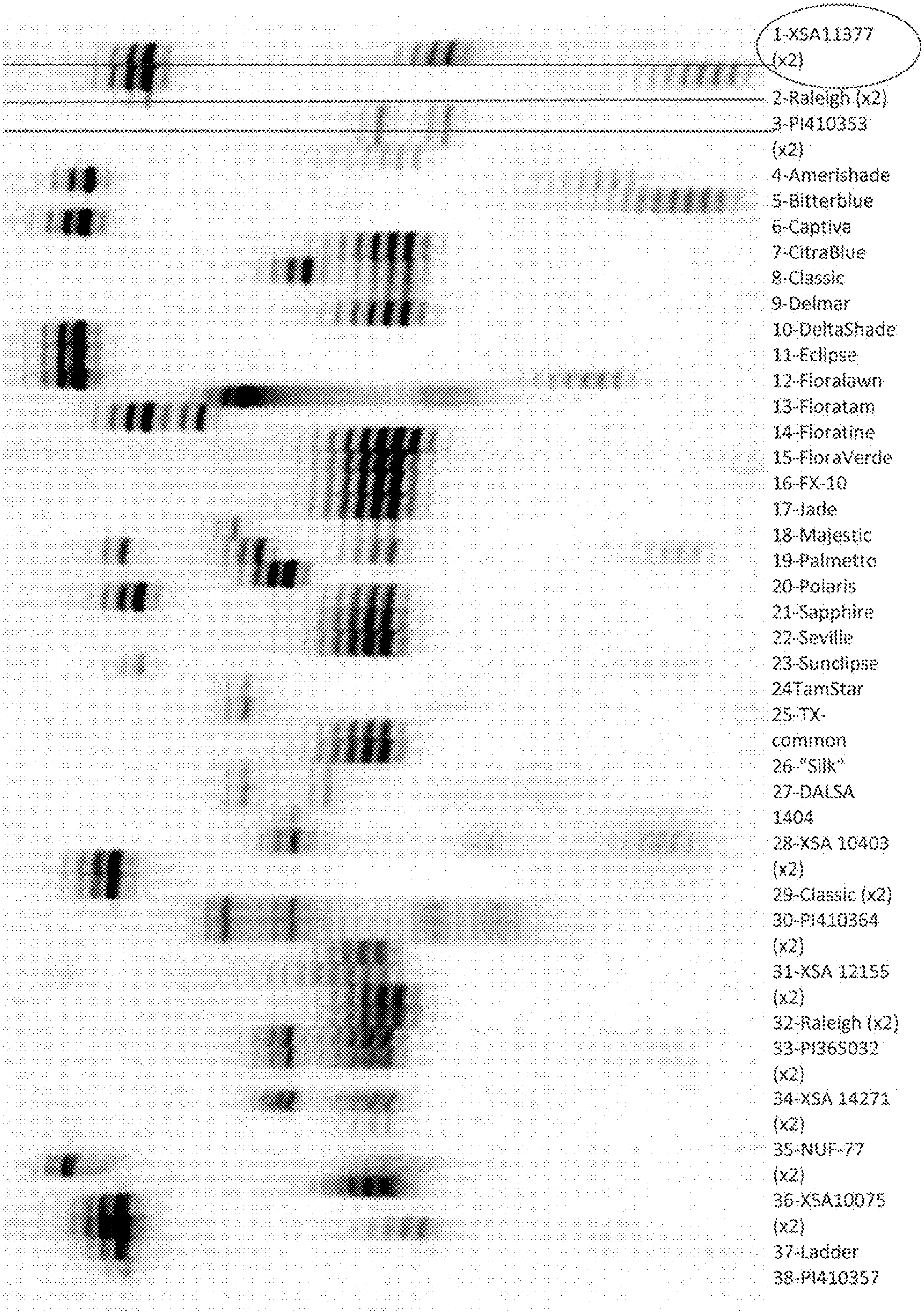
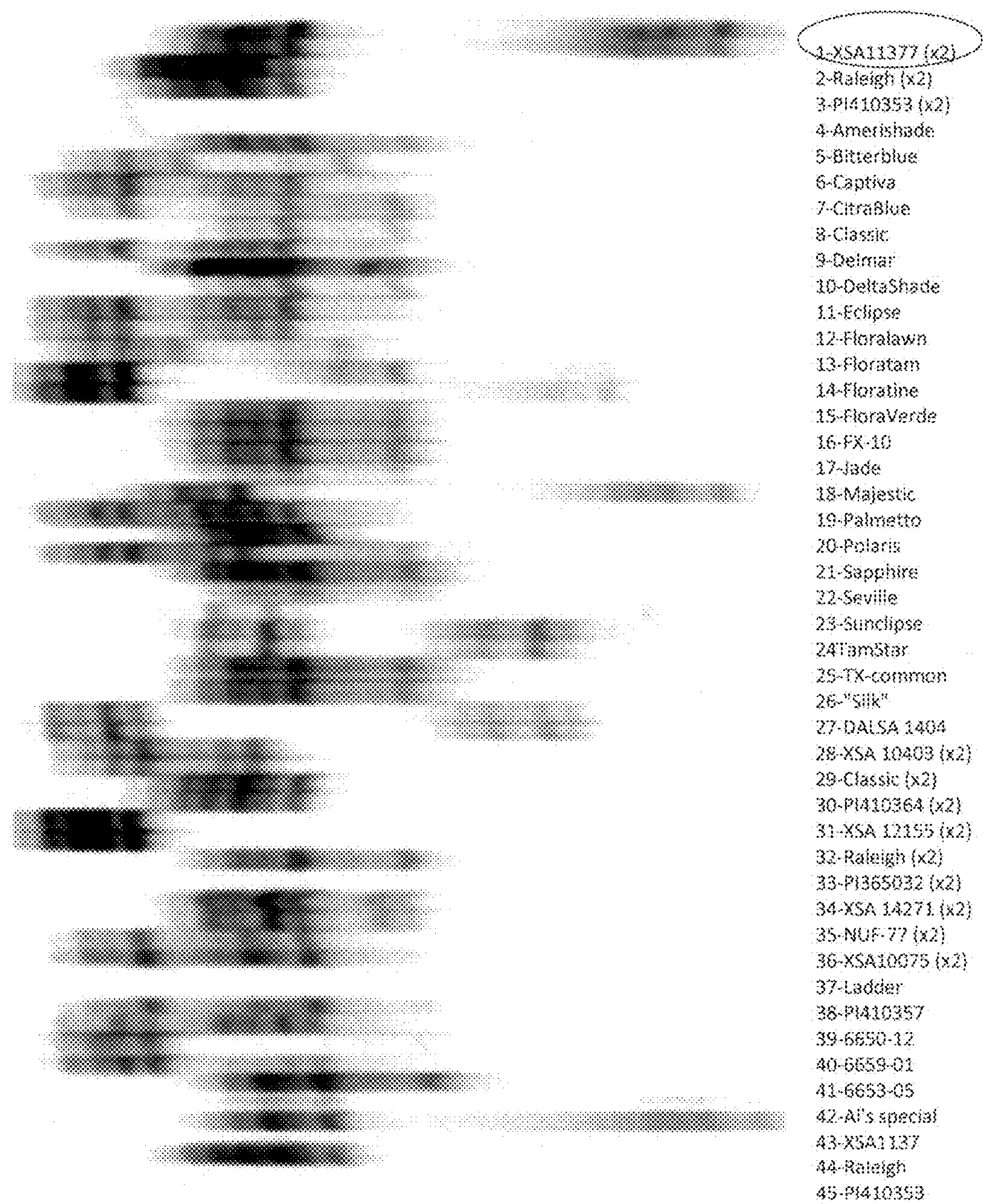

1-XSA11377 (x2)
2-Raleigh (x2)
3-PI410353 (x2)
4-Amerishade
5-Bitterblue
6-Captiva
7-CitraBlue
8-Classic
9-Delmar
10-DeltaShade
11-Eclipse
12-Floralawn
13-Floratam
14-Floratine
15-FloraVerde
16-FX-10
17-Jade
18-Majestic
19-Palmetto
20-Polaris
21-Sapphire
22-Seville
23-Sunclipse
24TamStar
25-TX-common
26-"Silk"
27-DALSA 1404
28-XSA 10403 (x2)
29-Classic (x2)
30-PI410364 (x2)
31-XSA 12155 (x2)
32-Raleigh (x2)
33-PI365032 (x2)
34-XSA 14271 (x2)
35-NUF-77 (x2)
36-XSA10075 (x2)
37-Ladder
38-PI410357

FIG. 14B


1-XSA11377 (x2)
2-Raleigh (x2)
3-PI410353 (x2)
4-Amerishade
5-Bitterblue
6-Captiva
7-CitraBlue
8-Classic
9-Delmar
10-DeltaShade
11-Eclipse
12-Floralawn
13-Floratam
14-Floratine
15-FloraVerde
16-FX-10
17-Jade
18-Majestic
19-Palmetto
20-Polaris
21-Sapphire
22-Seville
23-Sunclipse
24TamStar
25-TX-common
26-"Silk"
27-DALSA 1404
28-XSA 10403 (x2)
29-Classic (x2)
30-PI410364 (x2)
31-XSA 12155 (x2)
32-Raleigh (x2)
33-PI365032 (x2)
34-XSA 14271 (x2)
35-NUF-77 (x2)
36-XSA10075 (x2)
37-Ladder
38-PI410357
39-6650-12
40-6659-01
41-6653-05
42-Al's special
43-XSA1137
44-Raleigh
45-PI410353