Identifying Blackberry Cultivars by Seed Structure

S. Wada, H. Nonogaki, and B. Reed

The ability to correctly identify cultivars of commercially produced blackberry fruit is important to the industry. Less desirable cultivars may be mistaken or substituted for more desirable ones, resulting in mislabeled products and economic losses. But, identifying a blackberry cultivar by its fruit is often difficult. Fruit of an individual cultivar can vary, and fruit shape is similar among some cultivars.

Seed shape and structure are used to identify many plants. In a 2008 study of 56 types of blackberry and raspberry seeds, we found that seed coat structures and surface sculpturing are distinctive for each genotype. The shape and major surface features of the seed coat can be seen with a standard low power microscope (40X magnification).[1]

[1] At higher magnification (80–400X) with scanning electron microscopy (SEM), specific cell types and more distinctive seed coat structures are apparent. The distinctive patterns of seed coat sculpturing visible with SEM differentiate closely related cultivars and species. There are very diverse patterns of seed coat sculpturing on the many species of Rubus used in breeding cultivars.

Contents

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This manual was developed to give growers and processors a first step in identifying blackberry cultivars from samples of fruit. It includes 17 commercially grown blackberry cultivars.[2] Identity problems detected by this simple method can be followed up with DNA tests if needed for legal confirmation.

Seed Preparation

1. Soak about 1 cup of fruit in about 3 cups of water and add 1 tablespoon of pectinase. Mash and let sit for 24 hours at room temperature.
2. Extract seeds from fruit using a blender. Cover the blades with plastic tubing and set at a low speed. Use a high water-to-berry ratio (3:1). Blend for 2 minutes. Discard any floating seeds or fruit.
3. Pour the main mass of fruit pulp into a strainer, and wash it thoroughly in running water.
4. Mash the seeds against the strainer as needed to completely remove the fruit pulp.
5. Spread the seeds on paper towels. Let them air-dry at ambient temperature for 3 to 4 days.
6. Examine under a dissecting microscope at 40–80X.

Glossary

Chalaza: Basal end of the ovule

Cultivar: Cultivated variety; a single genotype propagated asexually

Genotype: The genetic makeup of an individual organism

Ovule: In seed plants, a small rounded structure, containing the embryo sac and surrounded by the nucellus that develops into a seed after fertilization

Raphe: Lower edge of a seed where it was attached to the mother plant

Reticulation: Network of ridges and valleys formed by the cells of the seed coat

SEM: Scanning electron microscope

References

Wada, S. and B. M. Reed. 2008. Morphological analysis of *Rubus* seed. Acta Hort. 782: 67-74.

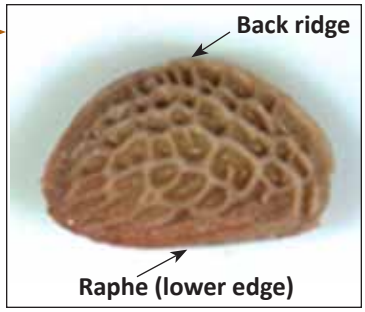
Wada, S. and B.M. Reed. 2010. Seed coat morphology differentiates blackberry cultivars. American Pomological Society. In press.

[2] Fruit was collected from plants identified as true to type in the National Clonal Germplasm Repository collections or from Dr. Chad Finn's breeding collections (USDA-ARS).

Blackberry Seed Identification Key

Based on the shape of the raphe, seed size and color

A. The seed has a straight lower edge.



1. Large seed:

a. **Cacanska Bestrna** (page 9)
Large, 4.20 mm L x 2.59 mm W
Light yellow-brown
0.31 g/100 seed

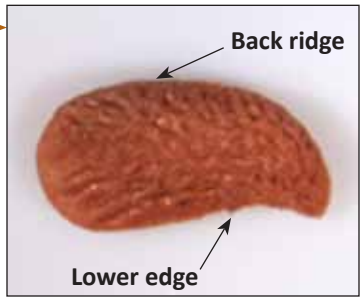
b. **Hull Thornless** (page 11)
Large and broad, 3.91 mm L x 3.01 mm W
Dark brown
0.43 g/100 seed

2. Medium seed:

a. **Loch Ness** (page 13)
Medium and broad, 3.37 mm L x 2.14 mm W
Medium brown
0.22 g/100 seed

b. **Chester Thornless** (page 10)
Medium, 3.19 mm L x 2.33 mm W
Purple-brown to mauve
0.28 g/100 seed

B. The lower edge is deeply concave.



1. Medium seed:

a. **Black Diamond** (page 6)
Medium to small and thin, 3.20 mm L x 1.96 mm W
Pink
0.20 g/100 seed

b. **Nightfall** (page 17)
Medium, 3.60 mm L x 2.00 mm W
Medium pink
0.15 g/100 seed

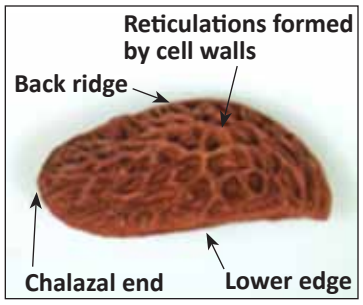
c. **Kotata** (page 12)
Medium to small, 3.48 mm L x 1.82 mm W
Light purple
0.21 g/100 seed

2. Small seed:

a. **Wild Treasure** (page 21)
Small and thin, 2.49 mm L x 1.63 mm W
Light purple
0.08 g/100 seed

Identification Key continued on next page

C. The lower edge is moderately to very slightly concave.



1. Large seed:

a. **Newberry** (ORUS 1324-1) (slight) (page 16)
   Large, 4.06 mm L x 2.09 mm W
   Light purple
   0.25 g/100 seed

b. **Boysen** (slight) (page 8)
   Large, 4.30 mm L x 2.54 mm W
   Purple
   0.32 g/100 seed

c. **Obsidian** (slight) (page 18)
   Large and long, 4.13 mm L x 1.96 mm W
   Dark brown-purple
   0.26 g/100 seed

2. Medium seed:

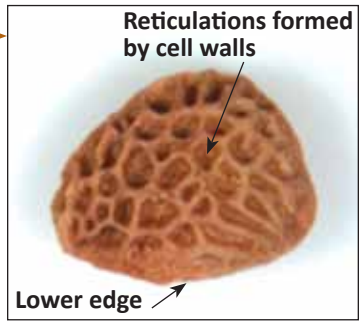
a. **Black Pearl** (moderate) (page 7)
   Medium, 3.81 mm L x 2.20 mm W
   Deep pink
   0.27 g/100 seed

b. **Marion** (slight-moderate) (page 14)
   Medium to small, 3.44 mm L x 2.06 mm W
   Deep rosy pink
   0.16 g/100 seed

c. **Silvan** (slight) (page 19)
   Medium to small, 3.04 mm L x 1.83 mm W
   Deep purple
   0.16 g/100 seed

d. **Young** (very slight) (page 22)
   Medium and long, 3.36 mm L x 1.71 mm W
   Salmon pink to yellow
   0.27 g/100 seed

D. The lower edge is convex.



a. **Navaho** (page 15)
   Medium, broad and short, 3.28 mm L x 2.44 mm W
   Dark purple
   0.29 g/100 seed

b. **Tupy** (page 20)
   Medium, 3.66 mm L x 2.34 mm W
   Light pink
   0.22 g/100 seed

Blackberry Seed Color Chart

Black Diamond

Black Pearl

Boysen

Cacanska Bestrna

Chester Thornless

Hull Thornless

Kotata

Loch Ness

Marion

Navaho

Newberry

Nightfall

Obsidian

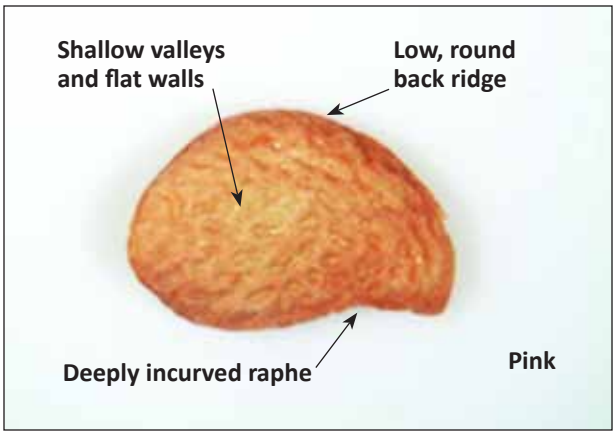
Silvan

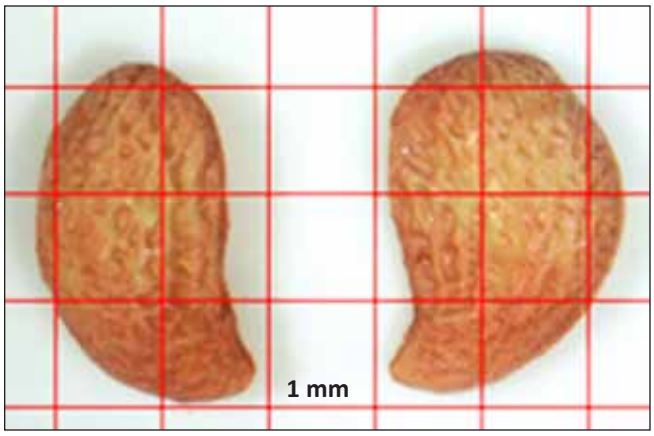
Tupy

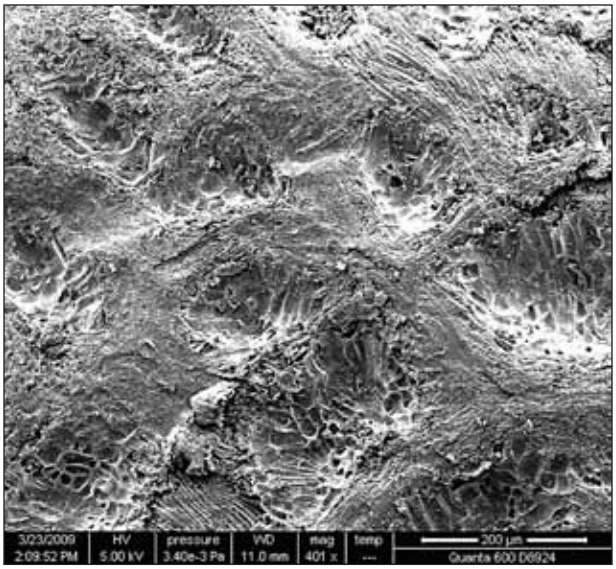
Wild Treasure

Black Diamond

1. Pedigree: Kotata x NZ 8610L-163 (E 90 x N 71)
2. Characteristics:
   a. Pink. Flat surface with insignificant surface reticulation and shallow valleys, rounded back ridges, distinctive hook (deeply incurved raphe).
   b. Medium size to small and thin; avg. 3.20 mm L x 1.96 mm W, 0.20 g /100 seed.
   c. Seed coat morphology is similar to 'Kotata', but 'Kotata' is longer and narrower and light purple rather than pink.

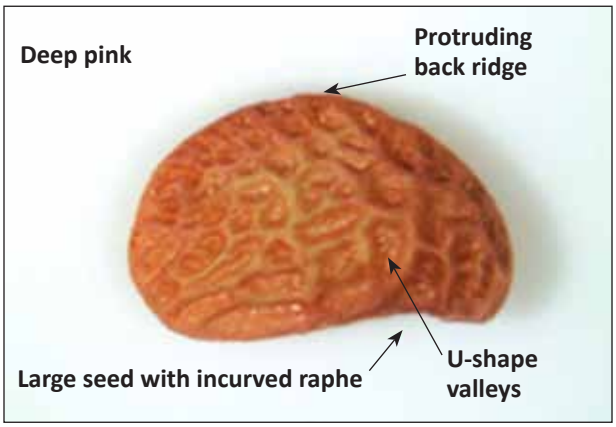


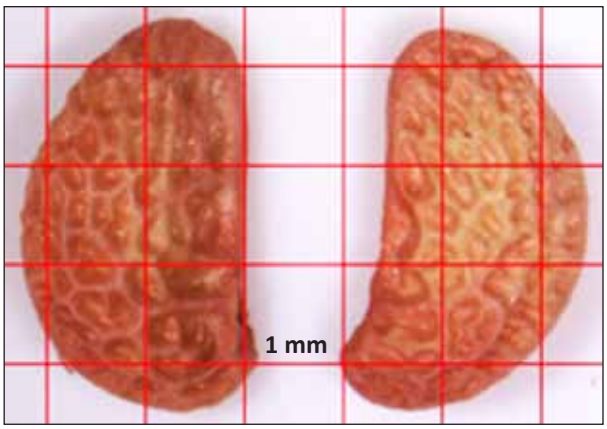


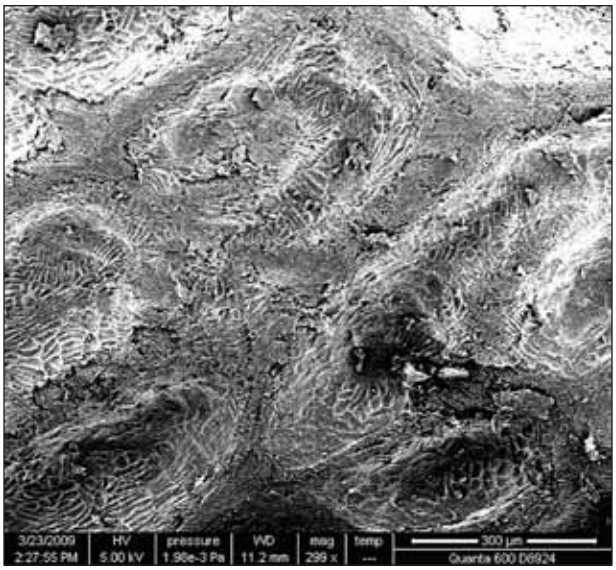


Black Pearl

1. Pedigree: ORUS 1117-11 x ORUS 1122-1
2. Characteristics:
   a. Deep pink. Protruding back ridge, moderate reticulation with U-shape valleys, moderate hook (incurved raphe).
   b. Medium size, avg. 3.81 mm L x 2.20 mm W, 0.27 g /100 seed.
   c. Seed is larger, darker pink, and with deeper reticulations than 'Black Diamond'.

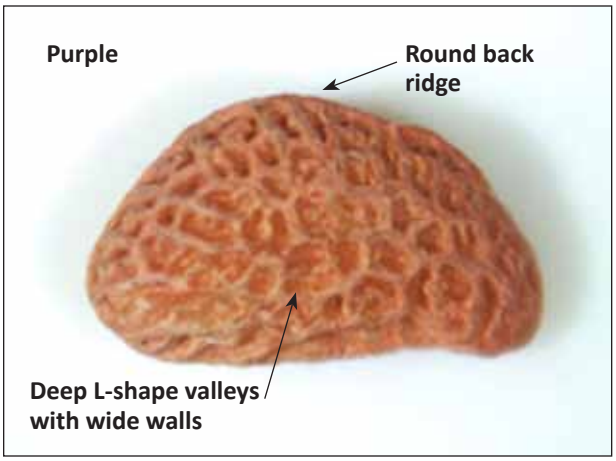


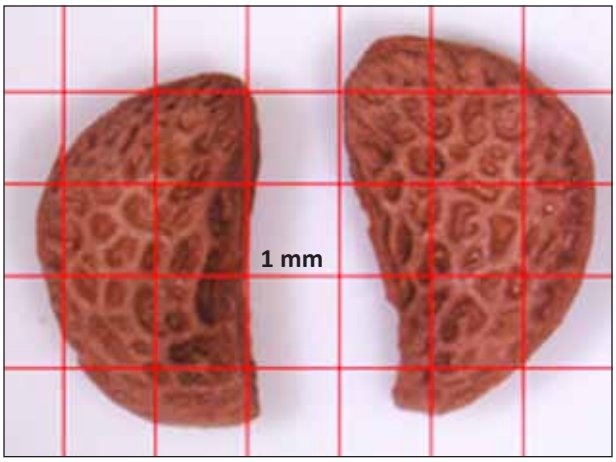


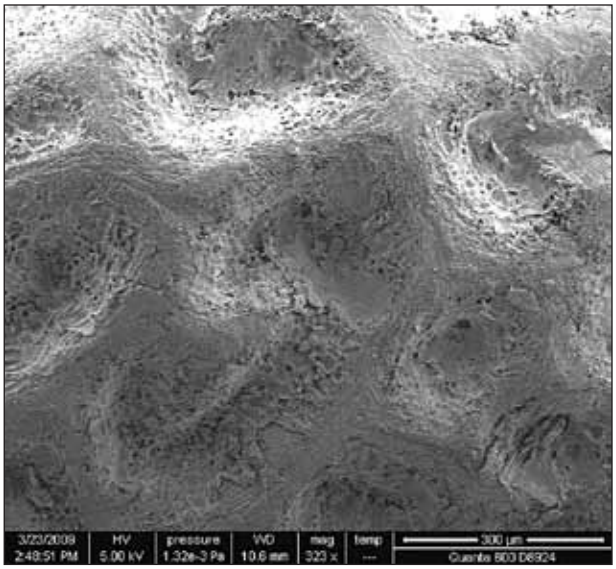


Boysen

1. Pedigree: Obscure, but it may be from a hybrid between *R. ursinus* (maternal) x *R. idaeus* (paternal) or a selection of *R. ursinus* var. loganobaccus.
2. Characteristics:
   a. Purple. Round back ridge, deep L-shape valleys with wide walls. Slight hook (incurved raphe).
   b. Large seed, avg. 4.30 mm L x 2.54 mm W, 0.32 g /100 seed.
   c. Similar to raspberry seed structure.

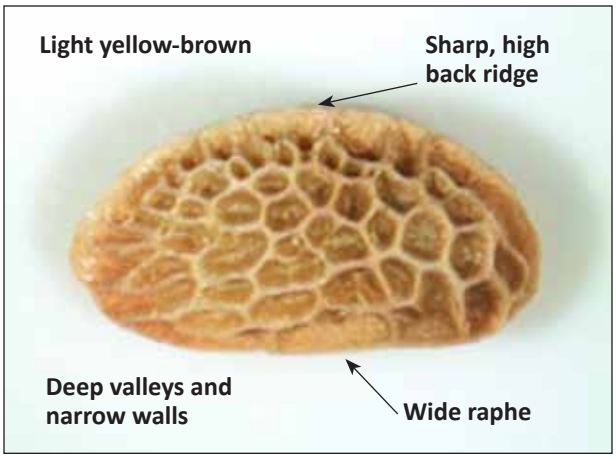


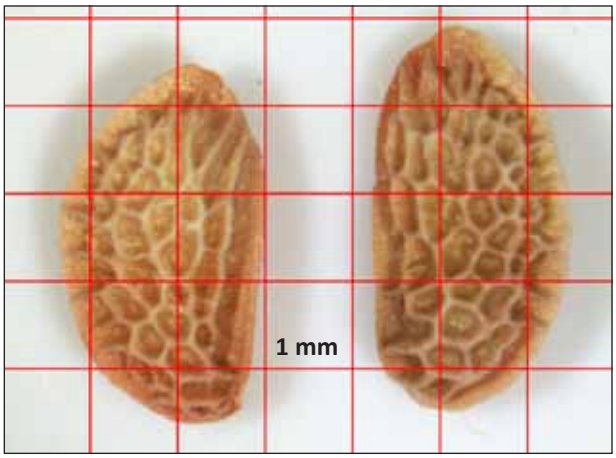


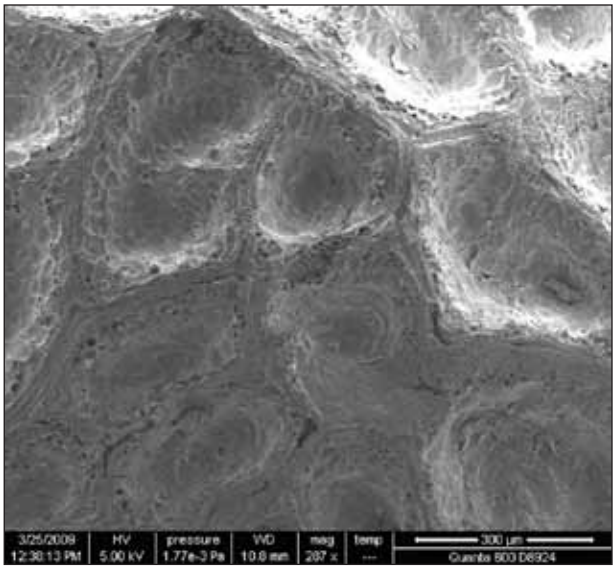


Cacanska Bestrna

1. Pedigree: Dirksen Thornless x Black Satin
2. Characteristics:
   a. Light yellow-brown. Unique, with high walls and deep valleys with narrow edges. Sharp back ridge (0.43 mm) and flat, wide raphal region (0.3 mm). Straight raphal region (no hook).
   b. Large seed, avg. 4.20 mm L x 2.59 mm W, 0.31 g /100 seed.
   c. Similar reticulations to 'Hull Thornless' and 'Chester Thornless' but larger and lighter brown.

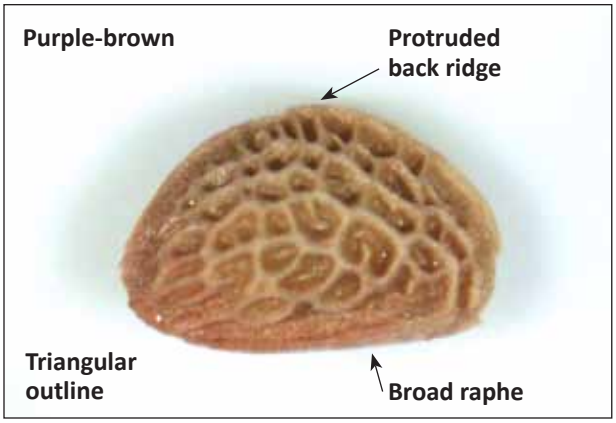


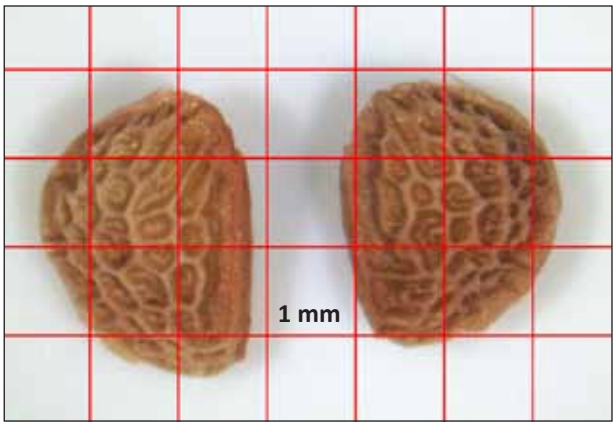


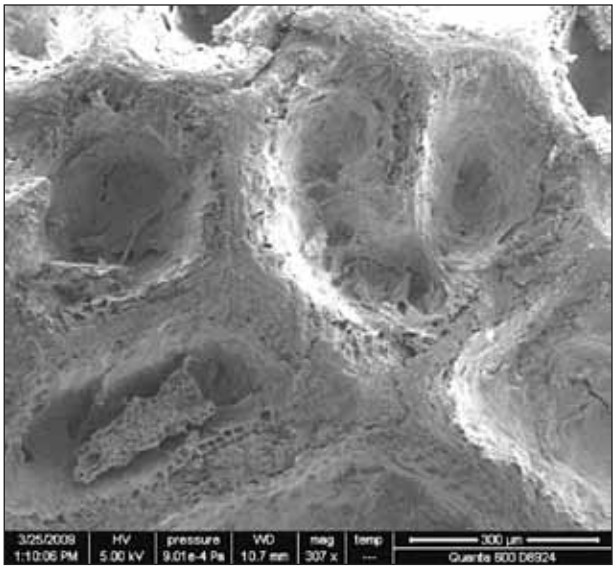


Chester Thornless

1. Pedigree: SIUS 47 (US 1482 x Darrow) x Thornfree
2. Characteristics:
   a. Purple-brown to mauve. Deep reticulations with narrow walls, protruded back ridge (0.3 mm), triangular outline. Broad straight raphal region (no hook) 0.3 mm wide.
   b. Medium size, avg. 3.19 mm L x 2.33 mm W, 0.28 g /100 seed.
   c. Seed coat morphology somewhat similar to 'Cacanska Bestrna' but smaller in both length and width.

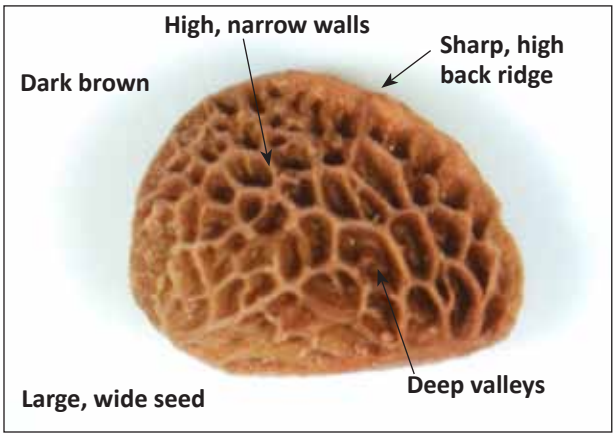


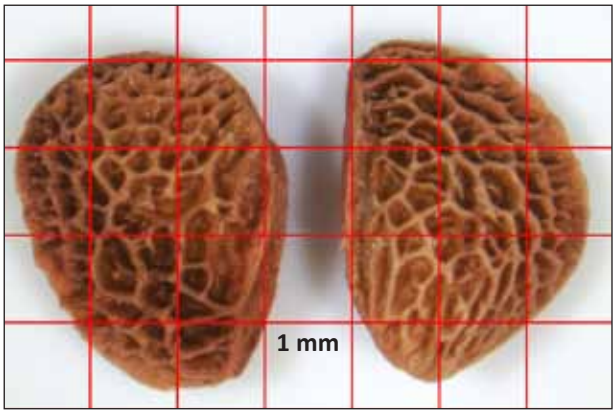


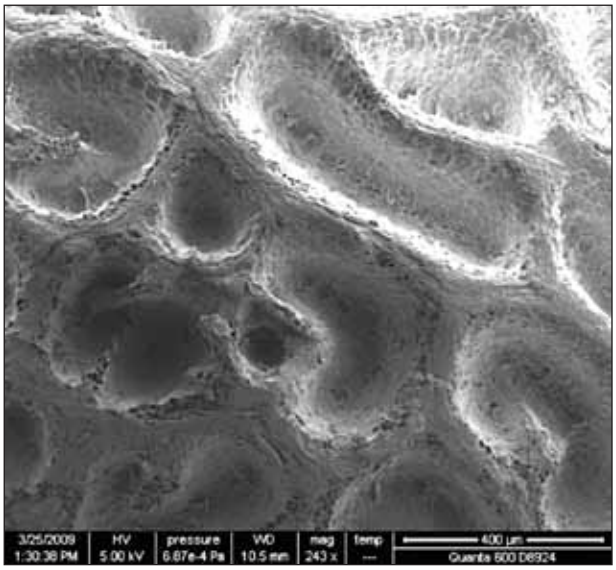


Hull Thornless

1. Pedigree: SIUS 47 (US 1482 x Darrow) x Thornfree
2. Characteristics:
   a. Dark brown. Prominent reticulation; deep, sharply curved L-shape valleys; high, narrow walls; high, sharp back ridges; straight raphal edge (no hook).
   b. Large, broad seed, avg. 3.91 mm L x 3.01 mm W, 0.43 g /100 seed.
   c. Similar shape and reticulation to 'Chester Thornless' but larger and darker brown.

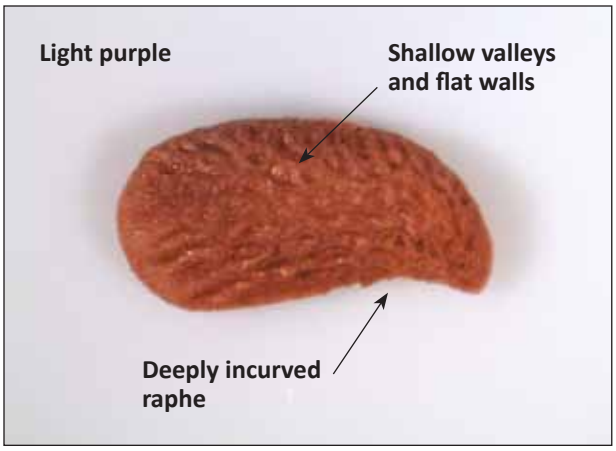


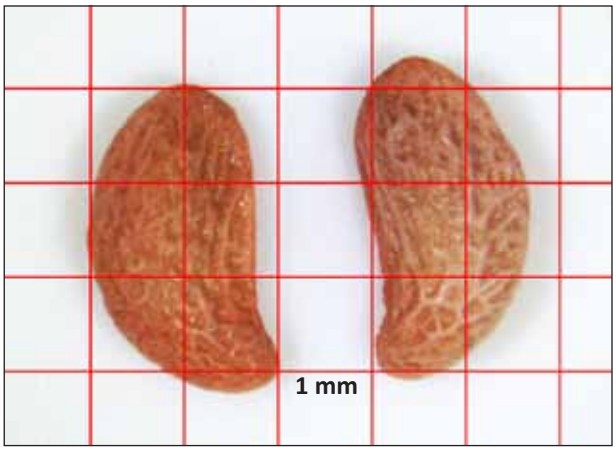


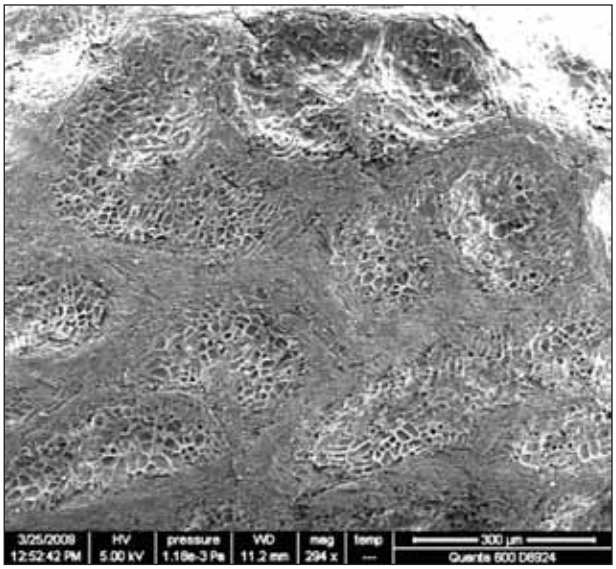


Kotata

1. Pedigree: OSC 743 (Pacific x Boysen) x OSC 877 (Jenner 1 x Eldorado)
2. Characteristics:
   a. Light purple. Flat, insignificant reticulations with shallow secondary walls; flat, round back ridges; deep incurved raphe (hook).
   b. Medium to small, narrow seed, avg. 3.48 mm L x 1.82 mm W, 0.21 g /100 seed.
   c. Seed coat morphology similar to 'Black Diamond' but slightly narrower and purple rather than pink.

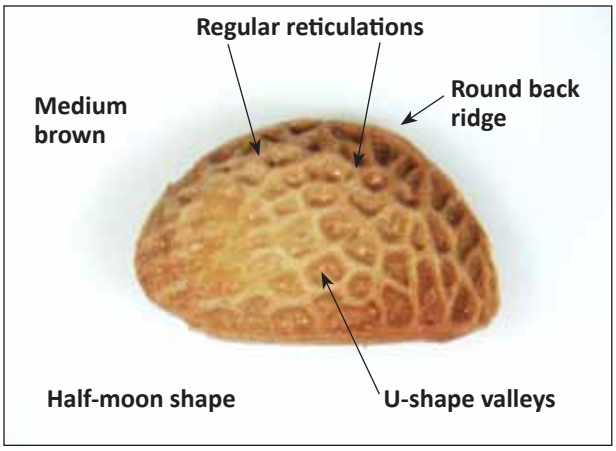


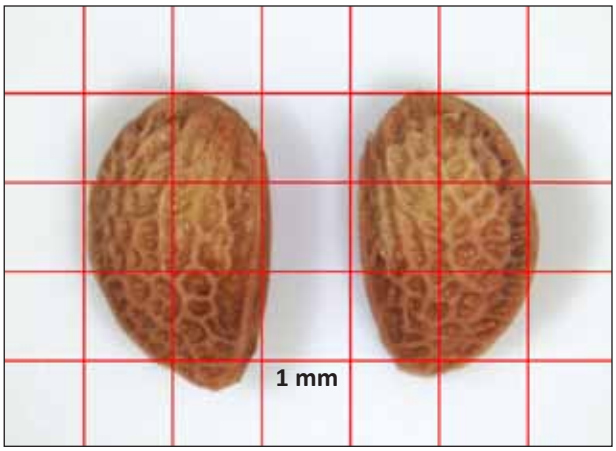


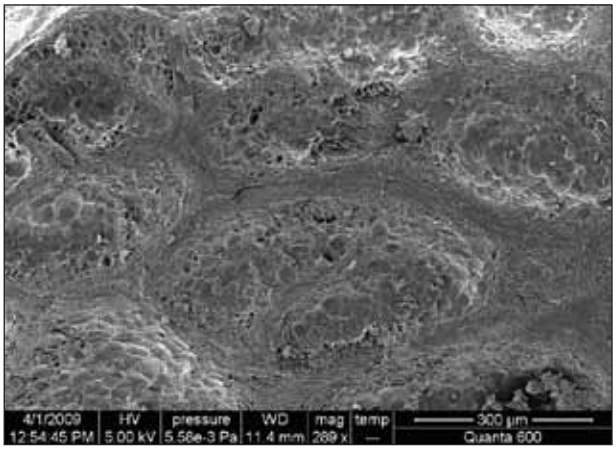


Loch Ness

1. Pedigree: 75131D1 x 74126RA8
2. Characteristics:
   a. Medium brown. Round back ridge and half-moon shape, U-shape valleys and regular-size reticulations. Straight raphal region (no hook).
   b. Medium and broad, avg. 3.37 mm L x 2.14 mm W, 0.22 g /100 seed.
   c. Similar to 'Chester Thornless' but longer and narrower. Seed is brown, not purple brown. Reticulations are not as deep.

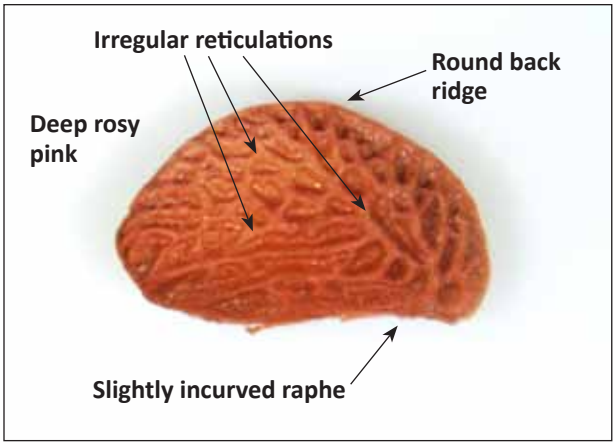


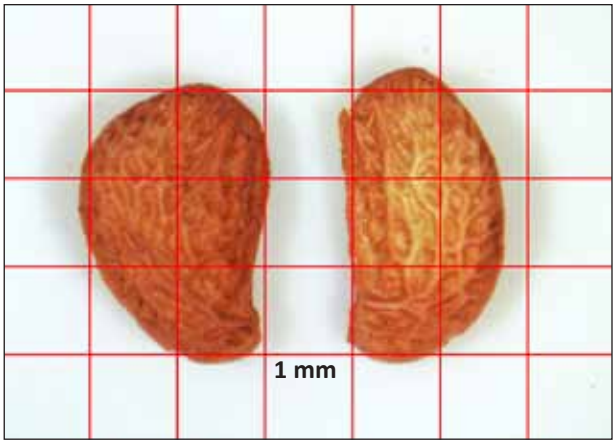


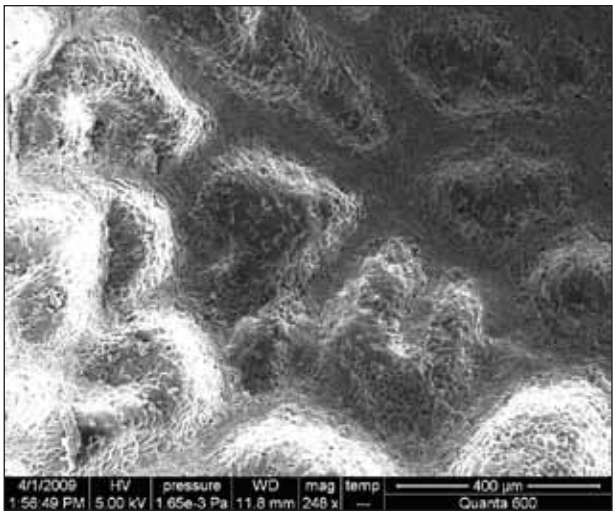


Marion

1. Pedigree: Chehalem (Santiam x Himalaya) x Olallie (Black Logan x Young)
2. Characteristics:
   a. Deep rosy pink. Deeper valleys than 'Kotata' and 'Black Diamond', irregular shape of reticulations (long I- and L-shape, triangular, round, rectangular and polygonal). Slightly incurved raphe (slight hook).
   b. Medium to small, avg. 3.44 mm L x 2.06 mm W, 0.16 g /100 seed.
   c. Similar reticulations to 'Black Diamond' and 'Black Pearl', but both of these cultivars are larger and lighter pink.

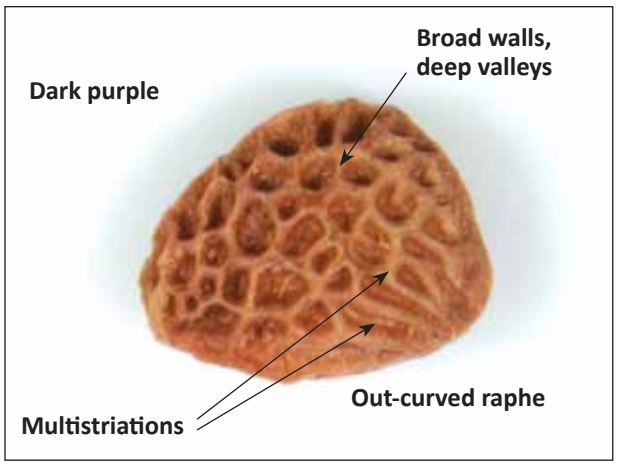


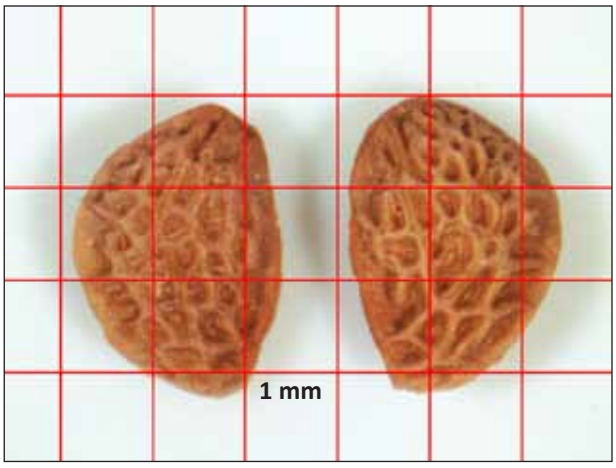


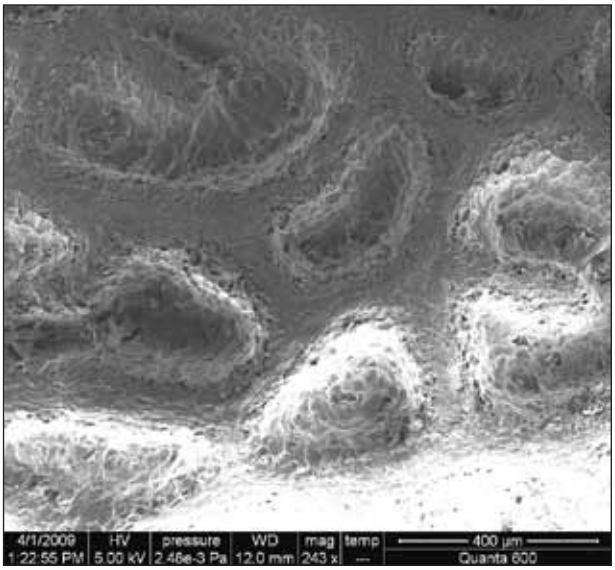


Navaho

1. Pedigree: Ark. 583 (Thornfree x Brazos) x Ark. 631 (Ark. 550 x Cherokee)
2. Characteristics:
   a. Dark purple. Triangular-shape seed, deeply U-shape valleys, round topped walls, broadly protruded back ridges, outcurved raphe region.
   b. Medium and broad/short, avg. 3.28 mm L x 2.44 mm W, 0.29 g /100 seed.
   c. Similar to 'Tupy' but purple rather than light pink, and somewhat rounder and smaller.

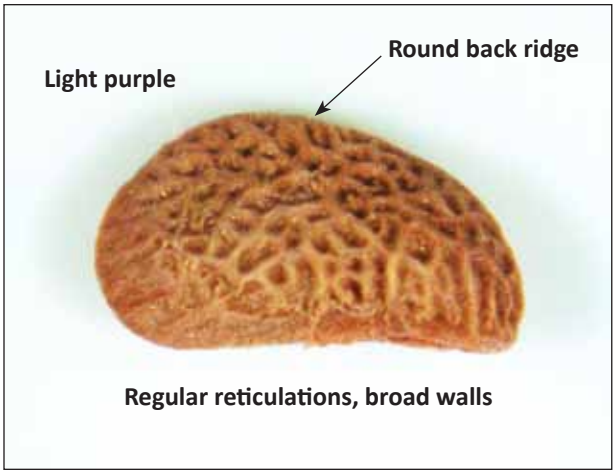


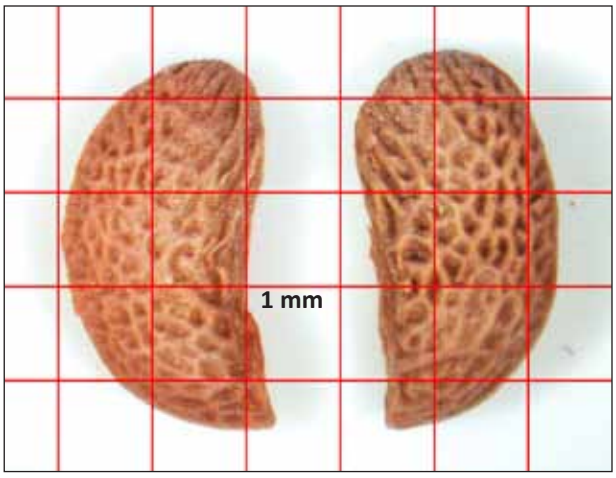


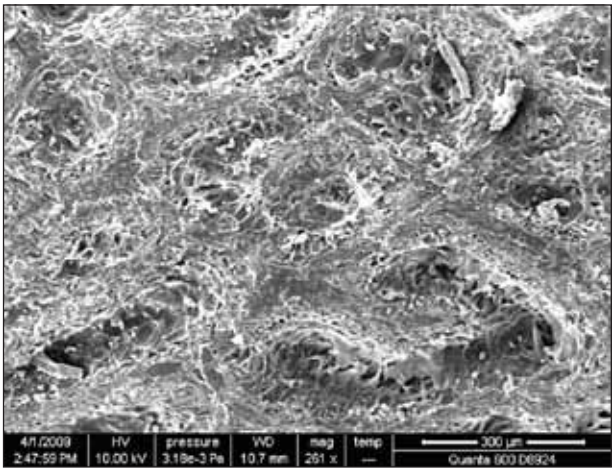


Newberry (ORUS 1324-1)

1. Pedigree: ORUS 834-5 (OSC 1826 x OSC 2024) x ORUS 1045-14 (OSC 880-1 x Austin Thornless)
2. Characteristics:
   a. Light purple. Regular reticulations and round back ridge, slightly incurved raphe (little hooking).
   b. Large, avg. 4.06 mm L x 2.09 mm W, 0.25 g /100 seed.
   c. Similar in sculpturing to 'Boysen' but larger and lighter.

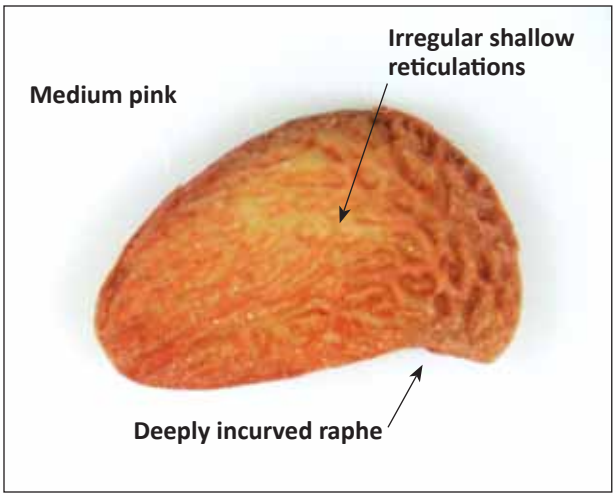


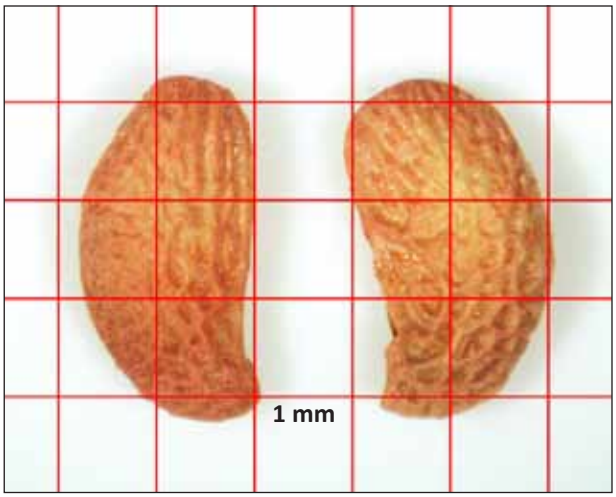


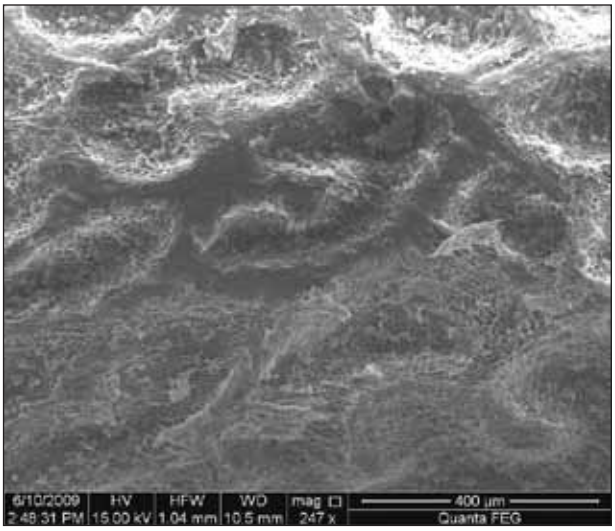


Nightfall

1. Pedigree: Marion x Waldo
2. Characteristics:
   a. Medium pink. Shallow U-shape valleys and low walls, deeply incurved raphe (hook).
   b. Medium size, avg. 3.6 mm L x 2.0 mm W, 0.15g /100 seed.
   c. Similar to 'Marion' but flatter, longer, and narrower and lighter pink. Shallower reticulations than 'Marion'.

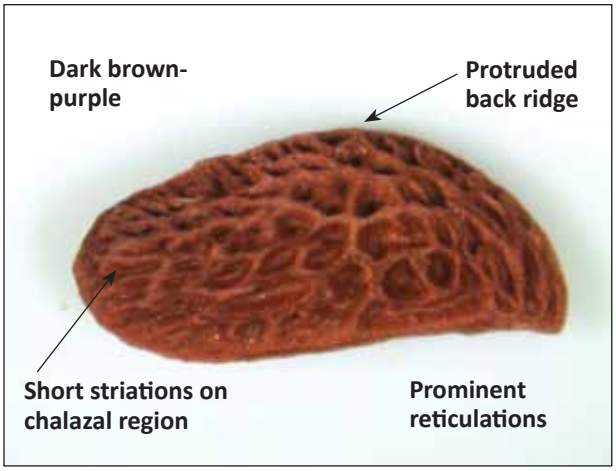


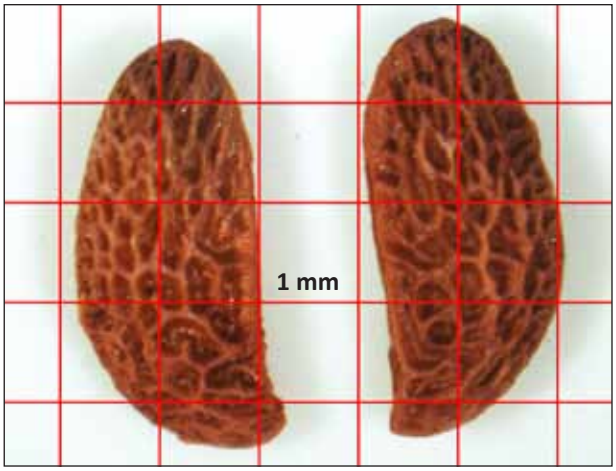


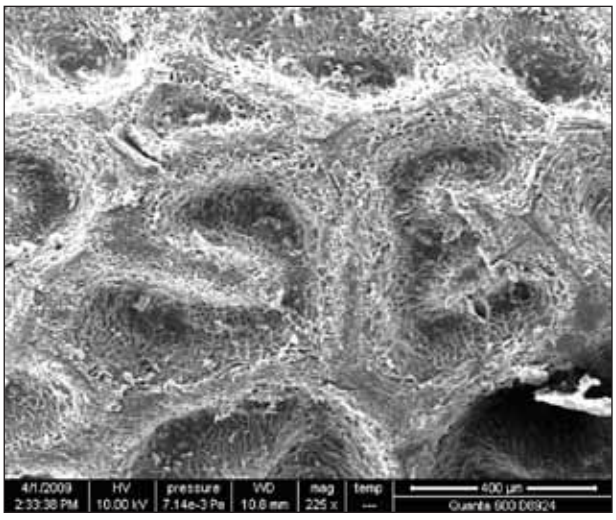


Obsidian

1. Pedigree: ORUS 828-43 (OSC 1122 x OSC 1683) x ORUS 1122-1 (Olallie x ORUS 728-3)
2. Characteristics:
   a. Dark brown-purple (the darkest of the 17 genotypes presented here). Long, narrow seed shape. Regular reticulations at the center, but multistriations with irregularities on chalazal region, and wide, high walls.
   b. Large and long, avg. 4.13 mm L x 1.96 mm W, 0.26 g /100 seed.
   c. Unique shape and color. Long, narrow, and darkest seed in the group.

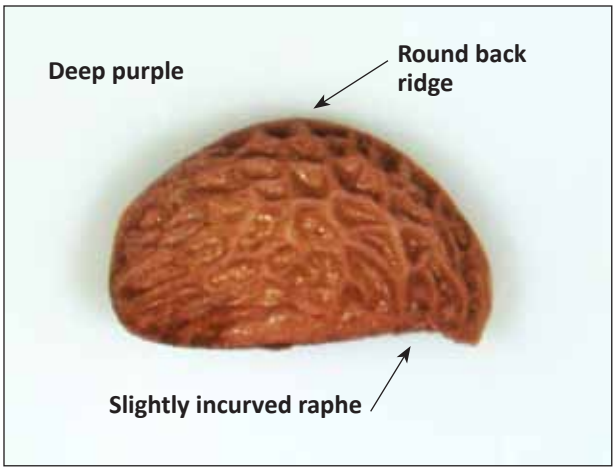


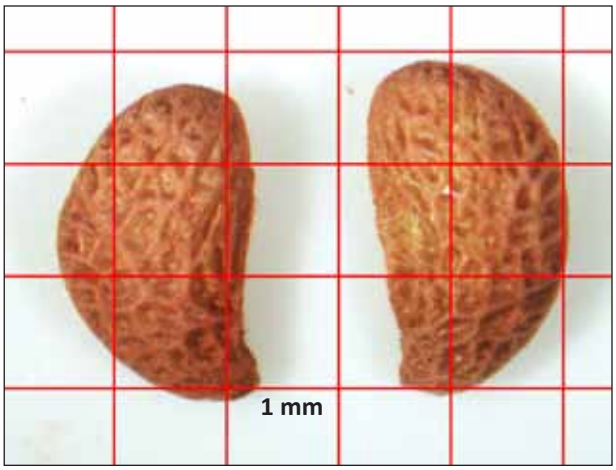


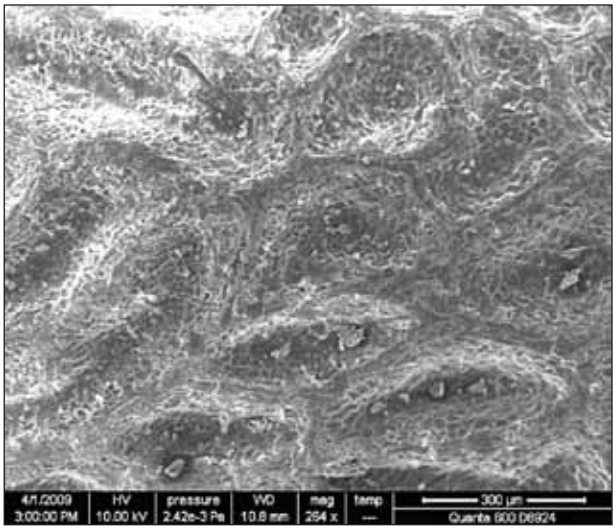


Silvan

1. Pedigree: OSC 742 (Pacific x Boysen) x Marion
2. Characteristics:
   a. Deep purple. Irregular-shape reticulations (long I-, L-, triangular and round valleys), incurved raphe and distinctive hook.
   b. Medium to small, avg. 3.04 mm L x 1.83 mm W, 0.16 g /100 seed.
   c. Similar to 'Marion' in outline, sculpturing, cell types and the ratio of length to width, but smaller and deep purple.

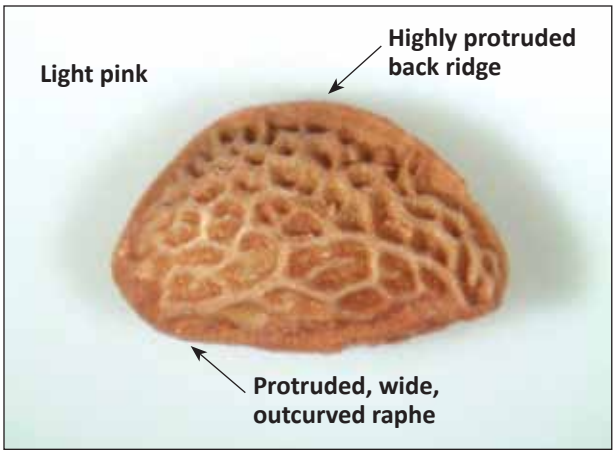


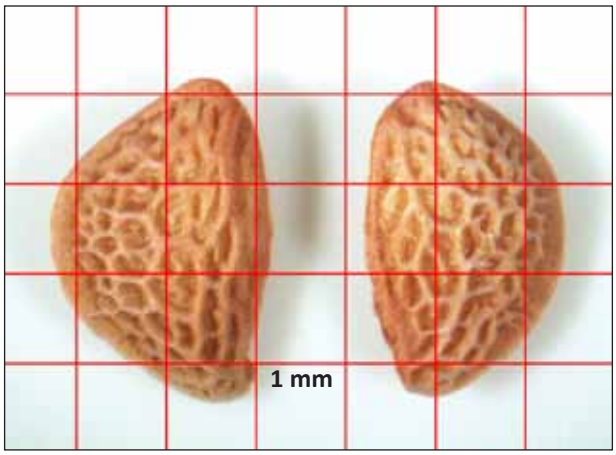




Tupy

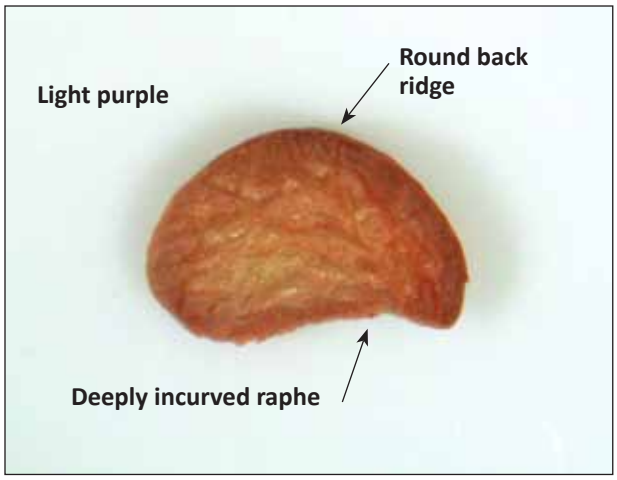
1. Pedigree: Obscure, but may be Comanche x Boysen
2. Characteristics:
   a. Light pink. A unique outline, compactly triangular, regular reticulations in the back ridge side of the seed; more irregular sculpturing patterns present in the lower half of the seed; outcurved raphe.
   b. Medium size, avg. 3.66 mm L x 2.34 mm W, 0.22 g /100 seed.
   c. Similar to 'Navaho' but longer and light pink rather than dark purple.

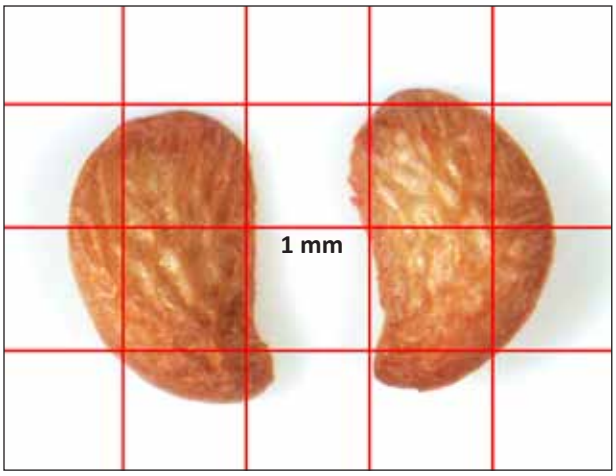


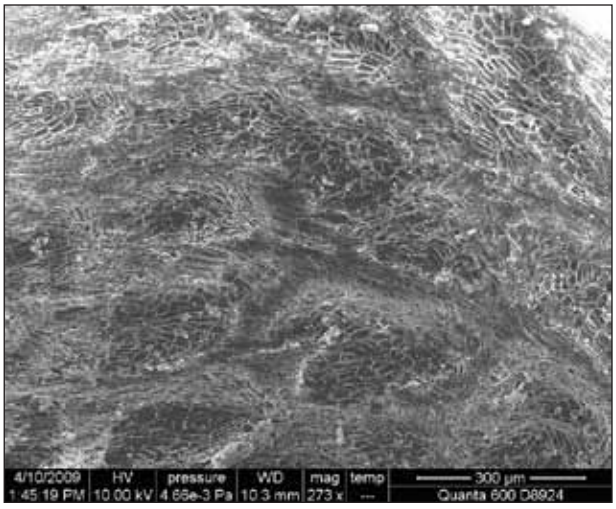


Wild Treasure

1. Pedigree: GP 9-24 (*R. ursinus* selection) x Waldo
2. Characteristics:
   a. Light purple. Small flat seed, insignificant reticulations, very shallow valleys and very low walls, deeply incurved raphe (hook).
   b. The smallest and thinnest of these 17 cultivars, avg. 2.49 mm L x 1.63 mm W, 0.08 g /100 seed.
   c. Distinctive from all others due to very small size.

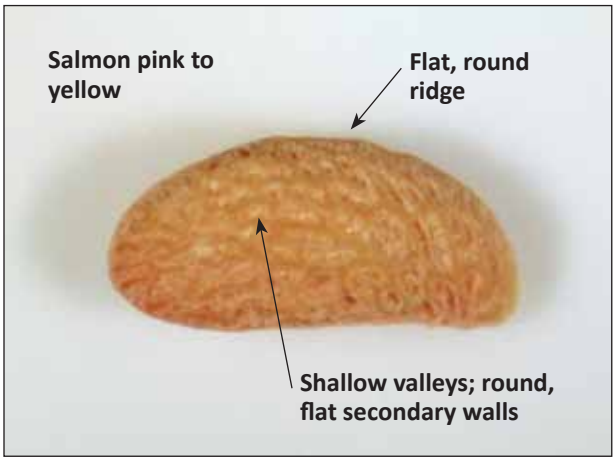


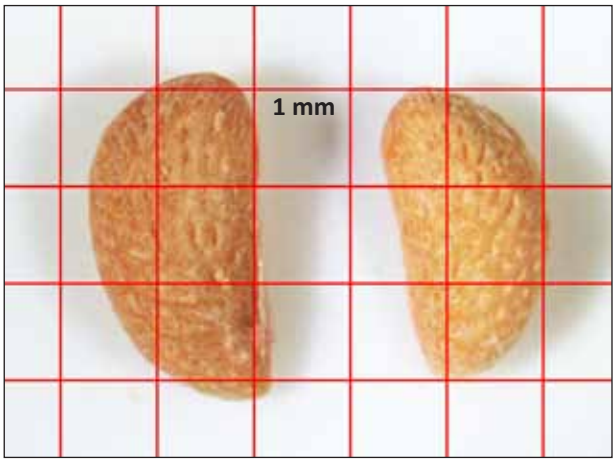


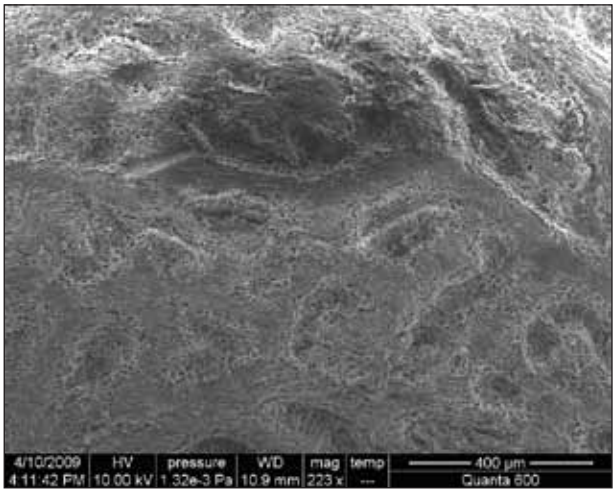


Young

1. Pedigree: Mayes x Phenomenal
2. Characteristics:
   a. Salmon pink to yellow. Low reticulation with shallow valleys and flat, low walls; flat, round back ridge; very slightly incurved raphe.
   b. Medium and long, avg. 3.36 mm L x 1.71 mm W, 0.27 g /100 seed.
   c. Distinctive color and shape.







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