
# 2010 Organic Broccoli Variety Trial Results

The following tables present the results of organic broccoli variety trials that took place on research stations and cooperating farms in Washington, Oregon, Wisconsin, Minnesota, and New York in 2010. These trials were part of the USDA-OREI funded project “Northern Organic Variety Improvement Collaborative”. Trials will continue in 2011, 2012, and 2013.

Detailed descriptions of the trial methods and rating systems are listed after the results tables.

Table 1: NOVIC 2010 Washington Broccoli Data

| Variety Name | Number of Prime Heads | Percent Prime Heads | Head Weight (kg) | Head Color (1-9) | Bead Size (1-3) | Heat Stress (1-9) | Leaf Trim (1-3) | Notes |
|---|---|---|---|---|---|---|---|---|
| Arcadia | 12.67 ab | 0.50 ab | 0.41 ab | 3.38 a | 1.38 a | 1.25 a | 1.00 a | Beautiful, harvested by farm crew earlier |
| Belstar | 10.25 b | 0.42 ab | 0.44 a | 2.80 a | 1.20 a | 0.60 a | 1.80 a | |
| East Coast Pop | 8.75 b | 0.40 ab | 0.21 ab | 3.50 a | 3.38 a | 3.00 a | 2.00 a | variable heads, long sid shoots already some cat facing |
| Green Goliath | 11.75 b | 0.50 ab | 0.23 ab | 2.90 a | 2.40 a | 2.00 a | 1.80 a | roundedheads,very convex, minor cat facing, nice heads rounded heads |
| Green Magic | 9.00 b | 0.32 b | 0.25 ab | 3.00 a | 2.50 a | 1.25 a | 1.75 a | lots of leaf, harvested earlier by farm crew, |
| Gypsy | 15.50 ab | 0.55 ab | 0.39 ab | 3.60 a | 1.60 a | 1.00 a | 1.60 a | nicest large heads of trial |
| Jim Myers' Pop | 6.75 b | 0.34 b | 0.13 b | 3.25 a | 3.00 a | 2.00 a | 2.00 a | stressed |
| Jonathan Spiro's Pop | 12.25 ab | 0.35 ab | 0.17 ab | 4.00 a | 2.90 a | 3.60 a | 1.80 a | cat facing |
| Julie Puhich's Pop | 8.00 b | 0.32 b | 0.16 ab | 3.33 a | 2.17 a | 1.67 a | 1.67 a | poor heads small plants, stressed |
| Windsor | 27.00 a | 0.90 a | 0.30 ab | 4.50 a | 1.75 a | 1.00 a | 1.00 a | Beautiful, |

Trait scores are colored on a spectrum with green being best and red being worst. Letters after the scores represent groups of varities whose means are not significantly different for that trait. In other words, all the varities which have a score with an "a" after the number have essentially the same score for that trait. For more information about what the scores mean and how they were measured, please see the protocols at the end of this document.

Table 2: NOVIC 2010 Oregon Broccoli Data

| Variety Name | Number of Prime Heads | Percent Prime Heads | Head Weight (kg) | Head Color (1-9) | Bead Size (1-3) | Heat Stress (1-9) | Leaf Trim (1-3) | Notes |
|---|---|---|---|---|---|---|---|---|
| Arcadia | 16.83 a | 0.47 a | 0.16 abc | 2.25 b | 1.68 c | 1.10 ab | 2.32 a | lots of heat damage, |
| Belstar | 18.50 a | 0.52 a | 0.26 a | 2.30 b | 1.66 c | 1.50 ab | 2.64 a | big leaf scars on stems, thick stems, only 6 prime heads in plot, rest 3-4 days, |
| East Coast Pop | 10.17 a | 0.33 a | 0.10 c | 2.67 ab | 3.92 a | 1.50 ab | 2.40 a | aphid damage primarly on leaves, |
| Fiesta | 14.83 a | 0.41 a | 0.23 ab | 2.70 ab | 1.65 c | 1.70 ab | 2.40 a | coarse bead, nice uniformity in size and height, 3 flowering, major heat stress (8.4); discoloration, segmentation, lots of heat damage, |
| Green Goliath | 19.50 a | 0.57 a | 0.16 bc | 2.75 ab | 2.13 bc | 3.40 a | 2.50 a | big beautiful heads; very uniform, rosetting, looser heads than wintergreen and persephone; fair bit of aphid damage on heads, |
| Gypsy | 17.50 a | 0.49 a | 0.13 bc | 2.75 ab | 1.62 c | 3.00 ab | 2.17 a | Very vigorous plant growth; good canopy cover; large heads., |
| Jim Myers' Pop | 15.83 a | 0.59 a | 0.09 c | 3.40 ab | 3.08 ab | 1.67 ab | 2.05 a | maybe a day or two early, heads soft but small, aphid damage primarily on head, |
| Jonathan Spiro's Pop | 10.00 a | 0.44 a | 0.06 c | 3.83 a | 3.97 a | 0.33 b | 1.78 a | coarse bead size, 9 flowering (one head extremely extended), |
| Julie Puhich's Pop | 11.50 a | 0.45 a | 0.07 c | 3.67 a | 3.37 ab | 1.33 ab | 2.03 a | |

Trait scores are colored on a spectrum with green being best and red being worst. Letters after the scores represent groups of varities whose means are not significantly different for that trait. In other words, all the varities which have a score with an "a" after the number have essentially the same score for that trait. For more information about what the scores mean and how they were measured, please see the protocols at the end of this document.

Table 3: NOVIC 2010 Wisconsin Broccoli Data

| Variety Name | Head Weight (kg) | Head Color (1-9) | Head Firmness (1-9) | Bead Size (1-3) | Heat Stress (1-9) | Notes |
|---|---|---|---|---|---|---|
| ? | 0.01 a | 3.00 a | 1.00 b | 3.00 a | 4.00 a | label lost, no field map |
| Arcadia | 0.27 a | 2.80 a | 3.40 ab | 1.60 b | 2.40 a | last variety missing |
| Belstar | 0.29 a | 3.00 a | 4.60 a | 1.40 b | 2.00 a | Farmer Favorite, harvested starting 2 weeks prior–heads were leafy |
| East Coast Pop | 0.15 a | 2.67 a | 2.33 ab | 2.33 ab | 3.50 a | heads too small to measure, harvested 7/16 |
| Green Goliath | 0.21 a | 3.40 a | 3.80 a | 1.80 ab | 2.20 a | |
| Gypsy | 0.33 a | 3.40 a | 3.80 a | 1.40 b | 2.00 a | 1 head harvested around 7/14 |
| Jim Myers' Pop | 0.18 a | 2.67 a | 3.33 ab | 2.00 ab | 2.33 a | harvested a little later but close to Jim's. leaves inside heads |
| Jonathan Spiro's Pop | 0.14 a | 3.00 a | 3.00 ab | 2.00 ab | 2.00 a | Other 3 varities missing, |
| Julie Puhich's Pop | 0.18 a | 2.80 a | 2.60 ab | 2.00 ab | 2.50 a | harvested 7/16 |
| Windsor | 0.18 a | 3.60 a | 4.00 a | 1.60 b | 2.20 a | Other 6 varieties missing, Mary harvested 7/16 |

Trait scores are colored on a spectrum with green being best and red being worst. Letters after the scores represent groups of varities whose means are not significantly different for that trait. In other words, all the varities which have a score with an "a" after the number have essentially the same score for that trait. For more information about what the scores mean and how they were measured, please see the protocols at the end of this document.

Table 4: NOVIC 2010 New York Broccoli Data

| Variety Name | Head Weight (kg) | Head Firmness (1-9) | Bead Size (1-3) | Heat Stress (1-9) | Notes |
|---|---|---|---|---|---|
| Arcadia | 0.09 bc | 4.33 a | 1.67 ab | 1.67 a | June 23- not heading yet, nice color, uniform; July 26 Arcadia showing a lot of heat stress, not marketable, June 23- not heading yet, nice color, uniform; July 26 Arcadia showing a lot of heat stress, not marketable, June 23- not heading yet, nice color, healthy, uniform; July 26 Arcadia showing a lot of heat stress, not marketable |
| Belstar | 0.20 a | 3.33 ab | 1.00 b | 1.67 a | June 23- short plants, uniform, healthy, no heads; All harvested heads from Belstar had a lot of heat stress, not marketable, bad color, leaves in head, uneven dome, June 23- short plants, uniform, good color, healthy, no heads; All harvested heads from Belstar had a lot of heat stress, not marketable, bad color, leaves in head, uneven dome, June 23- short plants, uniform, healthy, no heads; All harvested heads from Belstar had a lot of heat stress, not marketable, bad color, leaves in head, uneven dome |
| East Coast Pop | 0.11 abc | 2.50 b | 3.33 a | 2.67 a | June 23- plants not uniform, heading, bolting, cut 3 heads, some small plants, June 23- shorter plants, not uniform, bolting, cut 4 heads, June 23- not uniform, not good color, pale, bolting, tarnished plant bugs present, cut 6 heads |
| Green Goliath | 0.14 abc | 4.00 ab | 2.00 ab | 2.00 a | June 23- smaller plants than Arcadia, nice color, uniform, starting to head, tight heads; Juy 7- Imported cabbage worms present, June 23- good color, plants not uniform, starting to head, tight heads, uniform head color (nice green), June 23- nice plants, smallish, good color, starting to head, uniform |
| Gypsy | 0.14 abc | 5.00 a | 1.33 ab | 1.33 a | June 23- beautiful palnts, nice color, big, no heads, June 23- nice plants, uniform, no heads, June 23- Still awesome, starting to head |
| Jim Myers' Pop | 0.10 abc | 3.83 ab | 3.00 ab | 2.33 a | June 23- tall plants, not uniform, starting to head, tight heads, head color and size varies, 1 purple head, June 23- Plants not uniform, some heading, heads irregular size and color, June 23- tall plants, uniform, heading not uniform, head color varies, 1 unattractive yellow |

Table 4: *(continued)*

| Variety Name | Head Weight (kg) | Head Firmness (1-9) | Bead Size (1-3) | Heat Stress (1-9) | Notes |
|---|---|---|---|---|---|
| Julie Puhich's Pop | 0.09 bc | 4.50 a | 2.33 ab | 1.33 a | June 23- Plants not uniform, starting to head, heads not uniform in color or size, June 23 Plants not uniform, head and plant color not uniform, some heading, small heads, June 23- irregular, not uniform plaants and heads |
| Oregon Longneck | 0.07 c | 4.00 ab | 3.00 ab | 1.67 a | June 23- starting to head, tight heads, plants not uniform, color good, June 23- starting to head, heads and plants irregular- not uniform, June 23- tall plants, not uniform in size or color, starting to head- bolting, cut 2 heads (leaves in head) |
| Windsor | 0.18 ab | 4.67 a | 1.00 b | 1.83 a | June 23- Short, uniform plants, nice color, starting to head, June 23- nice big plants, uniform, good color, starting to head, tight heads, June 23- nice plants, uniform, starting to head, tight heads |

Trait scores are colored on a spectrum with green being best and red being worst. Letters after the scores represent groups of varities whose means are not significantly different for that trait. In other words, all the varities which have a score with an "a" after the number have essentially the same score for that trait. For more information about what the scores mean and how they were measured, please see the protocols at the end of this document.

**NOVIC Broccoli Variety Trial Protocol**

With funding from the Oregon Organic Crop Research special grants program, we conducted a broccoli variety trial in 2009 that can be considered a pilot study for the NOVIC broccoli trials.

Lewis Brown Research Farm: this farm is the location for the replicated "hub" trial. It has been managed organically for the past five years and will be certified in 2010. Soil building activities have been limited, so biological activity at the site is low. Equipment at the farm is set up for planting in 30 inch rows, and this is probably the greatest difference between the research farm and commercial organic farms.

Organic farms: farms vary in bed arrangements from three rows per bed on 12 – 18 inch row spacing although one farm has two rows per bed at 18 inches. Beds are separated by a wider row (24 – 36 inches) to allow equipment to pass up and down the row.

Transplant production: Transplants are started in an OSU greenhouse. While pesticides are used in the facility, they are excluded from the house used for organic production. OMRI certified certified potting mix is used (Sungro organic blend professional growing mix - unfertilized from OBC Northwest Supply Inc., Canby, OR). Plants fertilized with Alaska brand fish fertilizer (7-1-1). Transplants are started in mid April for transfer to the field during the 3$^{rd}$ week of May.

Experimental Design:

Broccoli descriptors: The following are traits that growers indicated are the most important to evaluate:

- Non-uniformity in head size and maturity
- Flea Beetles
- Aphids
- Buttoning
- Overall head size

These have been incorporated into the following set of evaluation parameters:

**Traits measured in the field:**

- *Days to harvest:* record the date upon which the heads are harvested.
- *Plant uniformity:* broccoli is notorious for uneven maturity. In some plots, we were hard put to find 5 heads at prime maturity out of 36 plants. Count separately number of prime, young and over mature heads
- *Regrowth potential:* Some growers take the main head then will cut side shoots 2 -3 times (Up to five trips through the field before it becomes uneconomical to continue harvesting). For these growers, varieties that produce abundant side shoots are preferred. We estimated side shoot production by examining the amount of growth produced by axillary buds at the time of harvest. Rating is on a scale of 1 – 3 where 1 is low (most axillary buds dormant); 2 is medium (some axillary buds have broken and shoots less than 3 cm have developed; 3 is high where most axillary buds have well developed shoots > 3 cm.

- *Insect damage:* Type of insect damage may vary from location to location. The three pests expected to cause the most damage in Oregon are flea beetle, cabbage butterfly (and related lepidoptern pests), and aphids. We rated flea beetle damage on a 3 point scale based on the number of plants in the plot that showed damage and the amount of damage to the leaves.
- *Foliar diseases:* Fungal and bacterial diseases may be important in certain regions, however, we did not experience any significant disease in our OBOT trials. We would suggest using a 1 – 9 scale based on incidence and severity of the disease.
- *Canopy and head height:* In our breeding program we have been selecting for tall plants with exserted heads. In processed broccoli, this type of plant architecture is preferred to facilitate mechanical harvest whereas in fresh market broccoli this is more of a social justice/labor safety issue in that tall plants require less bending over and ease the labor of harvest by hand. We measured canopy height to the highest leaf of an average plant in the plot. In unreplicated on farm plots, we took three measurements per plot whereas in replicated on station trials we took one measurement per plot. Head height is measured to the highest point on the crown on a typical plant in the plot (3 heads on farm, 1 head on station).
- *Harvest:* Five heads are harvested for yield. Heads are chosen such that they are at prime maturity, and from the center row (if on a 3 row bed). Avoid end plants and harvesting from the border rows of the bed (although given the variability of broccoli, it may be necessary in some plots to take heads from the borders to obtain a sample size of 5 heads). Heads should be cut at least 6 inches below the top of the crown. Do not trim excess leaves.
- *Plant vigor:* As an estimate of plant vigor we obtained fresh weight from three plants per plot. Harvest 3 typical plants (with heads) from the plot for biomass measurements. The stem is cut at the soil surface.

**Post harvest: These measurements are generally taken from materials harvested in the field and brought to the field laboratory. To prepare heads, stems on heads are cut to exactly 6 inches on a marked board.**

- *Biomass:* (see plant vigor above).
- *Head size and weight:* Lay 5 heads just touching side by side along a meter stick and record the length divided by 5. Weight the five heads and record.
- *Head color:* Rating scale of 1 – 9 where 1 is light green and 9 is dark blue-green.
- *Head firmness:* Scale of 1 – 9 where 1 = very loose, 3 = soft, 5 = intermediate, 7 = medium hard, 9 = very firm.
- *Bead size:* Beads are the individual immature flowers on a broccoli head (botanically speaking these are florets, but the term "florets" in broccoli refers to the small heads (approximately 1.5 – 3 inches in diameter) left after coring the head). Bead size is rated on a 1 – 3 scale where 1 is fine, 2 is medium, and 3 is coarse.
- *Heat stress:* Heat stress will cause leafy heads, uneven bead and floret development, including cat's eye (florets appear large and leafy), and starring or rosetting (center beads in a floret under developed compared to outer beads). Rated on a scale of 1 - 9 where 1 = none, 3 = low, 5 = noticeable, 7 = severe, 9 = unmarketable.
- *Leaves on stem below head:* In OBOT, we trimmed leaves from the head and weighed them separately to get an idea of the amount of trimming that must be done. We would propose in NOVIC leaving the leaves attached but rating for whether trimming is minimal (1), medium (2), or excessive (3).