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Spring Black Rot-Resistant Cabbage Cultivar Evaluation

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Most Kentucky cabbage producers sell directly to consumers at farmers' markets. Fourteen green fresh-market cabbage cultivars were evaluated in a replicated trial to evaluate their performance in Central Kentucky. This trial was conducted to evaluate cultivars listed in seed catalogs as having black rot (*Xanthomonas campestris*) resistance or tolerance, as this can be a problem in Kentucky.

Materials and Methods

Varieties were seeded on 12 February into 72-cell plastic plug trays filled with ProMix BX general growing medium (Premier Horticulture, Inc.) at the UK Horticulture Research Farm in Lexington. Greenhouse-grown transplants were set into the field in bare soil (Maury Silt loam) on 5 April, 12 inches apart in single rows with 36 inches between rows. Varieties were replicated four times in a randomized, complete block design. Each plot (replicate) row was 10 feet long and contained 11 plants. Prior to planting, Devrinol (3.3 lb/A) herbicide was tilled into the soil and Goal (1.5 pt/A) herbicide was applied to the soil surface.

Fifty pounds per acre of nitrogen, phosphorus and potassium were applied as 19-19-19, prior to planting, and tilled in. Approximately one cup per plant of starter solution (3 lb Miller Sol-U-Gro 12-48-8 in 50 gallons of water) was applied at transplanting. The plot was drip-irrigated and fertigated weekly with 2 lb of nitrogen per acre (using calcium nitrate) beginning on 15 May for a total of five fertigations and 10 lb of nitrogen per acre. Badge SC (1pt/A) was applied one time early in the season for disease control. Coragen insecticide (6 fl oz/A) was applied 21 May through the drip lines, and Danitol (10 oz/A), and Dipel (1.5 pt/A mixed with Scanner spreader/sticker at 5oz/A) were sprayed for insect control.

All heads were harvested when firm and were evaluated for total marketable yield based on weight and head number. Culled heads were weighed and evaluated for diseases and physiological defects. Harvesting began on 10 June, and continued on a roughly weekly basis through 15 July. One head from each of four replications was evaluated for head firmness (by feel), raw taste, head roundness/flatness, internal and external appearance, and interior color by two horticulture department personnel and was measured for its head and core sizes (lengths and widths). Sugar content was measured as °Brix using a handheld refractometer (American Optical model 10431, Deerfield, IL).

Results and Discussion

The growing season was cool, wet and ideal for cabbage production. In spite of frequent rains, very few heads of any cultivar split. Bacterial soft rot and *Sclerotinia* stem rot did show up in a couple of cultivars and reduced yields. Harvest and head measurement data are shown in Table

1 and flavor and appearance ratings, and field plant ratings are in Table 2. Varieties are ranked based on total marketable yield in both tables. For most farm market producers, marketable yield is not the primary consideration for selecting a variety. Desired head size, appearance and quality are more important, so the following recommendations are based mainly on these characteristics, and a low cull percentage. All cultivars in the trial were similar in head firmness, interior and exterior color, and most had round heads, with 'Bravo' and 'Taurus' having slightly flattened heads.

Early-season cultivars (65-69-day maturity)
'Lucky Ball' was the best early cultivar with a 65-day catalogue maturity date. It was consistently tender, sweet to slightly sweet, had little to no sulfur aftertaste and a low cull percentage. Its 3.6 lb head was one of the smallest of the cultivars evaluated and thus well suited for retail markets, where a small head is desirable. 'Conqueror' was another good early cultivar with a listed 65-day maturity date, although in the taste evaluation it seemed less sweet than 'Lucky Ball', and had some sulfur aftertaste. It had medium-sized heads and the fourth-highest yield of all cultivars in the trial. It was the first to be completely harvested, and had a narrow harvest window, which would make it attractive for wholesale producers. Both 'Lucky Ball' and 'Conqueror' ranked highly for plant uniformity in the field.

Mid-season cultivars (70-84-day maturity)
'Bronco' was the best mid-season cultivar. It ranked highly for taste, was tender, juicy, and had little to no sulfur aftertaste. It was also one of the highest yielders, and had a medium-sized, round head. Its core was one of the larger ones measured. It also had a narrow harvest window, good uniformity in the field, and is described in a seed catalog as a good shipper. 'Bronco' would be a good choice for fresh-market and wholesale producers. 'Botran' had the highest yield in the trial, because of its large-sized, round head. It ranked highly for attractiveness and taste, with little or no sulfur aftertaste. 'Bravo', the standard in trial, was another good yielder with a large, slightly flattened head and a small core. It had some sulfur aftertaste, but was considered tender and juicy. 'Thunderhead' did not yield as well as the above cultivars, but had the smallest core of any cultivar evaluated. It had the smallest head length measurements of any cultivar in the trial, but was small- to mid-sized at four pounds. It had a high °Brix and was mild-tasting with some sulfur aftertaste. It had the widest harvest window of any cultivar in the trial, which may work well for growers looking for a steady supply of a small- to medium-sized, mid-season cultivar.

Late-season cultivars (90-110-day maturity)
These cultivars, 'Superstar', 'Capture', 'Tekila' and 'Taurus' tended to be dry and chewy, and left a burning sensation after chewing. Some showed tip-burn. These characteristics were consistent with cabbage grown in high temperatures. These cultivars also tended to be the lowest yielders. 'Superstar', an 85-day maturing cultivar, was an exception, being the fifth-highest yielder in the trial, had a high °Brix, and ranked highly for taste. It had medium to large, round heads. 'Superstar' may be a good cultivar to extend the cabbage market into summer.

We did not inoculate plants with *X. campestris*, the bacteria causing black rot. Crop rotation, proper plant spacing and weed control likely helped limit *X. campestris* buildup. Black rot was not encountered in this trial, so we could not measure the relative amounts of black rot resistance

each cultivar had. Still, these varieties would be good choices to guard against possible infection. Where growers have a history of black rot in their fields the highly resistant cultivars would be recommended.

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Table 1. Yields, head counts and head measurements, 2019.

Variety	Seed Source	Days to Harvest[1]	Total Marketable Yield (lb/A)[2]		Heads (No/A)	Avg Head Wt (lb)	Cull (% wt)[3]	Head Length (in)	Head Width (in)	Core Length (in)	Core Width (in)
Botran	SW	84	47400	A	9150	5.2	2.6	6.6	7.6	3.2	1.4
Bravo	HO	85	43300	AB	9150	4.7	1.0	6.9	8.0	2.9	1.3
Bronco	SW	80	39400	ABC	9150	4.3	1.3	7.1	6.9	3.1	1.6
Conqueror	SW	65	38700	ABC	9150	4.2	3.9	6.9	7.8	3.0	1.5
Superstar	SW	85	38200	ABC	8930	4.3	4.5	6.8	7.3	2.2	2.0
Taurus	SI	100-110	37300	ABCD	7620	5.0	9.8	6.6	7.7	3.6	1.5
Blue Dynasty	ST	75	36500	ABCD	9150	4.0	2.0	6.9	7.4	2.7	1.4
Thunderhead	ST	82	36000	BCD	8930	4.0	3.0	5.9	7.1	2.4	1.2
Capture	SW	85	34500	BCD	7620	4.5	12.6	6.6	7.3	2.6	1.3
Blue Vantage	ST	76-80	33300	BCD	8930	3.8	5.7	6.6	7.5	2.8	1.4
Lucky Ball	SI	65	32200	BCD	8710	3.6	2.3	6.9	7.4	2.8	1.5
Tekila	ST	90	29400	CD	8060	3.5	3.1	6.7	6.7	2.9	1.7
Bobcat	HO	80	29400	CD	8280	3.5	4.6	6.2	6.8	2.6	1.4
Early Thunder	ST	74	26600	D	8280	3.2	6.7	6.1	6.7	2.7	1.4

[1]Listed in seed catalogs

[2]Yields followed by the same letter are not significantly different (Waller-Duncan Test, LSD P≤0.05)

[3]Percent of the weight of all harvested heads

Table 2. Head evaluation ratings and comments, 2019.

Variety	External Appearance (1-5)[1]	Internal Appearance (1-5)[1]	Head Shape (1-3)[2]	Taste Raw (1-5)[1]	Sugar Content (°brix)[3]	Uniformity in Field[4]	Plant Size[5]	Comments and Disease Resistance[6]
Botran	4.7	4.6	2.0	4.7	5.3	3.9	3	Mid-season; slightly sweet, juicy, little/no sulfur taste, variable tenderness; HR: Y, BR
Bravo	4.6	4.6	1.4	4.4	5.4	4.0	3	Mid-season, long harvest period; tender, juicy, slight sulfur taste; HR: Y, IR: BR, TB
Bronco	4.4	4.5	2.0	4.7	5.8	4.3	2	Mid-season; short harvest period, juicy, tender, slightly sweet, little/no sulfur taste, lg core; R: Y, TB, TT, IR: BR
Conqueror	4.5	4.9	2.0	4.5	5.8	4.6	2	Very early, mild taste; HR: Y, IR: BR
Superstar	4.6	4.6	1.9	4.6	6.3	4.2	2.5	Late harvest, slightly sweet, little/no sulfur taste, hard; HR: Y, IR: BR
Taurus	4.7	4.0	1.5	4.2	5.1	4.4	3	Late harvest, some tip burn, little/no sulfur taste, lg core; R: Y, IR: BR
Blue Dynasty	4.7	4.6	2.0	4.4	6.0	4.0	2.6	Early harvest, little/no sulfur taste; R: BR, Y, TB
Thunderhead	4.7	4.6	1.6	4.5	6.1	3.9	2	Mid-season; very wide harvest window, very mild, slightly sweet, tender, small core; R: BR, IR: Y
Capture	4.6	4.3	1.6	3.9	6.3	4.1	3	Late harvest, little/no sulfur taste, small core; HR: Y, IR: BR
Blue Vantage	4.6	4.2	1.6	4.4	5.5	4.1	2	Early, wide harvest window, variable tenderness, little/no sulfur taste; R: BR, TB, BS, Y
Lucky Ball	4.1	4.3	2.0	4.5	5.6	4.3	1	Early, wide harvest window, tender, slightly sweet, little/no sulfur taste R: BR
Tekila	4.4	4.6	2.3	4.3	6.2	4.3	2.3	Late, very short harvest window, slightly sweet, not tender, variable sulfur taste, lg core, some tip burn; R: BR,CR
Bobcat	4.5	4.6	1.9	4.3	5.4	3.7	2	Early-mid, wide harvest window, tender, little/no sulfur taste; R: Y, BR, BS, TB
Early Thunder	4.4	4.6	1.9	4.4	5.3	3.8	2	Early, wide harvest window, little/no sulfur taste, slight/not sweet; IR: BR,Y

[1]1=poor; 5=excellent

[2]1=flattened; 2= round; 3=pointy

[3]Refractometer measurement of soluble solids (primarily sugars) in cabbage juice sample

[4]Uniformity of heads' size and maturity in field: 1=not uniform; 5=very uniform

[5]Relative size of plants compared to other cultivars: 1=small; 3=large

[6]Disease resistances from seed catalogs: HR=highly resistant; R=resistant; IR=intermediate resistance; BR=black rot; BS=black speck; CR=club root; TB=tip burn; TT=thrip tolerant; Y=Fusarium yellows