1997 Spring and Fall Cabbage Cultivar Trials in Pennsylvania

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SUMMARY. Twenty-two cabbage cultivars were evaluated in the spring and 26 cabbage cultivars evaluated in the fall of 1997. The cultivars were evaluated for uniformity of maturity, marketable yield, percent cull, stem core length, and head firmness. In addition, three heads of each cultivar were tasted at harvest by the summer farm crew and responses noted on the data collection forms. The highest yielding cultivars were not necessarily the best performing ones evaluated in the trial. Average head weight was significantly different between spring and fall plantings. Data from this trial suggests that multiple cultivars should be grown in Pennsylvania based on whether it is a spring or fall cabbage crop.

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Cabbage, *Brassica oleraceae* var. *capitata* L., has been a very important vegetable crop in Pennsylvania for the last 50 years. Cabbage has been primarily grown for the fresh wholesale and retail market with very little being used in the preprocessing or processing market. In the last 10 years, the acreage of cabbage has dropped $\approx 40\%$ in the state with most growers now growing cabbage for markets demanding very specific head size and quality. In addition, there has been a larger array of cabbage maturities developed by seed companies to fit these various market segments (Howell, 1999; Scaife et al., 1998). From previous experience, cabbage cultivars maturing in less than 105 d will consistently produce uniform, tight heads in most of Pennsylvania (Orzolek et al., 1999).

Materials and methods

The cultivar trial was located at the Horticulture Research Farm, Russell E. Larson Research Center, Rock Springs, Pa. Cabbage transplants were seeded on 17 March 1997 in 200-cell Speedling trays (Speedling, Inc., Sun City, Fla.) for the spring trial and on 13 June 1997 in 128-cell Speedling trays for the fall trial. The soil type was a Hagerstown silt loam with good drainage. On 27 April 1997 before transplanting in the spring, 40N-21.8P-83K lb/acre (44.4N-24.2P-93.3K kg·ha⁻¹) was broadcast on the fall plowed wheat field and harrowed to incorporate the fertilizer. For the fall trial, an additional 12 lb/acre of N was applied on 15 July 1997 followed by a harrow operation to incorporate the nitrogen. Cabbage cultivars were transplanted on 30 Apr. 1997 for the spring trial and on 21 July 1997 for the fall trial. The trial design was a randomized complete block with three replications. Individual plots consisted of 25 plants spaced 1 ft (30 cm) apart between plants with 5 ft (150 cm) between rows in the spring trial. In the fall, the individual plots consisted of 12 plants spaced 2 ft (60 cm) in-the-row and 3 ft (90 cm) between rows since conditions are generally more optimum for plant growth and plants require more space to reach maximum head size.

The spring trial was drip irrigated using drip tape [0.3 gal/min per 100 ft (1.1 L·min⁻¹ per 30 m)] (T-Tape International, San Diego, Calif.) hav-

ing 12-inch (30 cm) orifice spacing on 2 May, 6 May, 26 June, 3 July, 7 July, and 14 July 1997. The fall cabbage trial was irrigated only on 1 Aug. 1997. No major diseases were encountered during cabbage production throughout the entire growing season. For weed control oxyfluorfen (a.i.) was applied postemergence at 1 pt/acre (1.17 L·ha⁻¹) on 29 Apr. 1997. Insects were controlled with applications of imidacloprid (a.i.) at 0.11 oz/100 ft of row (3 g/30 m) 30 Apr. 1997, esfenvalerate (a.i.) at 8 fl oz/acre (585 mL·ha⁻¹) on 2 May 1997 and *Bacillus thuringiensis kurstaki* at 1.5 qt/acre (3.51 L·ha⁻¹) on 13 June and 2 July 1997. For the fall cabbage trial, there was no herbicide application before transplanting. Weed control was accomplished by harrowing to prepare soil for transplanting and one cultivation. There were moderate populations of cabbage loopers (*Trichoplusia ni* Hubner) and imported cabbage worms (*Pieris rapae* L.) during the fall cabbage cultivar trial requiring application of esfenvalerate (a.i.) at 8 oz/acre (585 mL·ha⁻¹) on 25 July 1997 and also on 25 Aug. 1997, imidacloprid (a.i.) at 0.11 oz/100 ft of row (3 g/30m) on 1 Aug. 1997 and *Bacillus thuringiensis kurstaki* at 1.5 qt/acre (3.51 L·ha⁻¹) on 25 Aug. 1997. Head quality characteristics were collected from three heads in the first replication only. Each of these heads were cut, measured, and tasted by the three person work crew.

Cabbage seeds were obtained from the following sources: Abbott and Cobb (Feasterville, Pa.), Asgrow Seed Co. (Seminis Vegetable Seeds, Saticoy, Calif.), Harris Moran Seed Co. (Modesto, Calif.), Petoseed (Seminis Vegetable Seeds, Saticoy, Calif.), Novartis Seeds (formerly Rogers NK Seed Co., Boise, Idaho) and Sakata Seed America (Morgan Hill, Calif.).

Results and discussion

SPRING 1997. All cabbage entries grew normally in the spring, but matured slowly due to the high temperatures experienced in July. 'Discovery' (Petoseed/Seminis), 'Augusta' (Novartis), 'Atlantis' (Petoseed/Seminis), 'Emblem' (Sakata), 'CB6' (Novartis), 'Columbia' (Petoseed/Seminis), 'CB2' (Novartis), 'Blue Ridge' (Asgrow/Seminis) and 'Blue Gem' (Harris Moran) were the top

Table 1. Yield of cabbage cultivars grown in the spring trial at the Pennsylvania State University, Rock Springs, Pa., 1997.

Cultivar	Seed source ^z	Total yield (tons/acre) ^y	Marketable head		Proportion of culls (%)
			Yield (tons/acre)	Avg Head wt (lb) ^x	
Discovery	Petoseed/Seminis	22.9	22.9	3.0	0
Augusta	Novartis	22.5	21.7	3.1	5
Atlantis	Petoseed/Seminis	19.0	18.8	3.2	12
Emblem	Sakata	19.6	18.7	3.2	14
CB6	Novartis	20.2	18.5	3.0	16
Columbia	Petoseed/Seminis	16.4	15.9	3.0	7
CB2	Novartis	17.5	15.6	2.4	19
Blue Ridge	Novartis	17.2	15.1	2.6	22
Blue Gem	Harris Moran	17.7	14.8	3.3	29
Cardinal	Harris Moran	15.0	14.2	2.3	15
Bravo	Harris Moran	17.3	14.1	3.0	34
Blue Thunder	Harris Moran	15.4	13.4	2.4	25
Blue Bayou	Asgrow/Seminis	22.2	12.8	3.4	49
XPH 15508	Asgrow/Seminis	12.7	12.5	3.1	5
XPH 5957	Asgrow/Seminis	15.6	12.4	2.5	32
XPH 15516	Asgrow/Seminis	15.5	11.7	2.5	34
XPH 15513	Asgrow/Seminis	15.2	11.3	2.4	35
XPH 15514	Asgrow/Seminis	20.4	10.5	3.1	48
XPH 15518	Asgrow/Seminis	13.9	10.1	2.4	30
XPH 15519	Asgrow/Seminis	11.7	8.2	2.2	42
XPH 15511	Asgrow/Seminis	9.5	7.9	2.2	36
XPH 15515	Asgrow/Seminis	17.0	5.1	2.6	73
LSD $P \leq 0.05$		7.6	8.6	0.7	

^zAsgrow Seed Co. (Seminis Vegetable Seeds), Saticoy, Calif.; HarrisMoran Seed Co., Modesto, Calif.; Petoseed (Seminis Vegetable Seeds), Saticoy, Calif.; Novartis Seeds (formerly Rogers NK Seed Co.), Boise, Idaho and Sakata Seed America, Morgan Hill, Calif.

^y1.0 ton/acre = 2.24 t·ha⁻¹.

^x1.0 lb = 0.45 kg.

Table 2. Head dimensions of cabbage cultivars grown in the spring cultivar trial at Pennsylvania State University, Rock Springs, Pa., 1997.

Head shape	Cultivar	Color	Head ht (inch) ^x	Head width (inch)	Core size ^z (inch ²) ^w	Head ^y firmness
Flat/Semi-flat: Head height/width ratio ≤ 0.8	XPH 15514	green	5.0	6.2	21.0	1.8
	XPH 15518	blue-green	5.1	6.0	21.1	2.0
	XPH 15519	blue	4.8	5.6	18.1	2.4
Round: Head height/width ratio 0.81 to 0.97	Blue Bayou	blue-green	5.6	6.1	23.7	1.4
	XPH 15513	green	5.4	5.8	18.2	1.6
	Bravo	blue-green	5.9	6.2	20.9	1.8
	Blue Ridge	blue-green	5.3	6.1	21.1	1.9
	Blue Gem	blue-green	5.7	6.2	23.0	1.9
	XPH 15516	blue	5.9	6.2	27.1	1.9
	XPH 15515	blue-green	5.5	5.8	26.2	2.1
	Augusta	blue-green	5.9	6.4	31.5	2.4
	XPH 15508	blue-green	6.7	5.9	16.4	1.4
Oblong: Head height / width ratio ≥ 0.98	Discovery	green	6.1	5.3	22.7	1.4
	CB 6	green	6.7	5.7	31.0	1.4
	Columbia	green	6.1	5.6	24.6	1.6
	Atlantis	green	6.4	5.3	17.2	1.6
	XPH 5957	blue-green	6.2	6.0	21.8	1.7
	CB 2	blue	5.8	5.7	19.3	1.8
	Cardinal	dark red	6.4	6.0	25.5	1.8
	Blue Thunder	blue	5.7	5.7	22.5	1.9
	XPH 15511	green	6.2	5.5	25.1	1.9
	Emblem	blue	6.1	6.3	27.1	2.0

^zDetermined by multiplying core height by core width.

^yVisually assessed on a scale of 1-5, with 1 being tight and 5 being loose.

^x1.0 inch = 2.54 cm.

^w1.0 inch² = 6.45 cm².

yielding cultivars based on marketable heads (Table 1). Of these cultivars, only 'CB6' from Novartis matured uniformly, although maturity occurred later than in the other cultivars. Most of the early-maturing cultivars required many harvests, while the later-maturing cultivars sized more uniformly. 'Augusta' was the only round-headed cabbage cultivar with a large core of the top nine yielding cultivars, while the other cultivars were more oblong or tapered in shape (Table 2). 'Atlantis' and 'Discovery' had the smallest internal cores of these five and produced very firm heads. 'CB6' also produced very firm heads but had a large internal core. 'Cardinal' was the only red cultivar available for the spring trial and produced a uniform yield of good quality 2.3-lb (1-kg) heads.

'Blue Bayou', 'Blue Gem', and 'Bravo' produced the largest heads but had the highest number of nonmarketable heads which lowered their marketable yields. 'XPH 15508' also

had large head size, but matured nonuniformly, with many heads never reaching marketable size within the time span of this study.

FALL 1997. All cultivars matured uniformly during the fall evaluation. The total number of heads harvested was reduced in some cultivars due to a delay in maturity or head sizing. 'Blue Gem', 'Emblem', and 'Augusta' were the three top-yielding cultivars in the fall trial (Table 3). 'Blue Gem' had a medium/large frame with red leaf margins, a medium-sized core, and an average head size of 6.6 lb (3 kg). 'Emblem' (Sakata) had a large frame and produced a round head which was moderately loose, had an extremely large core, and an average head size of 6.6 lb (3 kg). 'Augusta' (Novartis) produced a very firm round head averaging 6.3 lb (2.9 kg) with a medium-sized core on a medium-large framed plant. Head dimensions and head characteristics are presented for the fall cabbage cultivars in Table 4.

A new cultivar from Asgrow/Seminis, 'XPH 15508', was notable for its excellent quality. It produced high yields of very sweet 6-lb (2.7-kg) heads with very small cores and good firmness. Of the red cabbage cultivars evaluated in the fall, '831 YR' (Abbott and Cobb) matured earliest but produced oblong or pointy heads with a very large internal core. '841' (Abbott and Cobb) had a smaller core and was more round but was less firm than '831 YR'.

Overall, total yield of most cabbage cultivars evaluated in the fall appeared similar to spring yields keeping in mind the fall trial had one-half the plant population of the spring trial. Yields of marketable cabbage were significantly higher in the fall trial compared to the spring trial mainly due to less favorable growing conditions experienced in the spring, specifically, below optimum temperature for cabbage development and head formation.

Table 3. Yield of cabbage cultivars grown in the fall cultivar trial at Pennsylvania State University, Rock Springs, Pa., 1997.^z

Cultivar	Seed source	Total yield	
		Yield (tons/acre) ^y	Avg wt (lb) ^x
White cabbage			
Blue Gem	Harris Moran	23.3	6.6
Emblem	Sakata	23.2	6.6
Augusta	Novartis	22.3	6.3
Bravo	Harris Moran	21.1	6.7
XPH 15508	Asgrow/Seminis	20.8	6.1
Blue Bayou	Asgrow/Seminis	20.5	5.8
XPH 15514	Asgrow/Seminis	20.3	5.7
XPH 5957	Asgrow/Seminis	19.8	5.9
Columbia	Petoseed/Seminis	19.5	5.5
XPH 15515	Asgrow/Seminis	18.8	5.3
XPH 15516	Asgrow/Seminis	18.6	5.4
Atlantis	Petoseed/Seminis	17.9	5.5
Discovery	Petoseed/Seminis	17.6	5.1
Blue Ridge	Asgrow/Seminis	17.2	4.9
Blue Thunder	Harris Moran	17.0	6.4
CB 6	Novartis	16.7	5.3
CB 2	Novartis	16.6	5.0
780	Abbott and Cobb	16.4	4.9
XPH 15518	Asgrow/Seminis	16.0	4.8
XPH 15513	Asgrow/Seminis	15.8	5.6
XPH 15511	Asgrow/Seminis	13.7	4.4
790	Abbott and Cobb	12.0	5.3
XPH 15519	Asgrow/Seminis	11.0	4.3
Red cabbage			
831 YR	Abbott and Cobb	17.1	4.8
841	Abbott and Cobb	14.8	4.3
Cardinal	Harris Moran	12.2	4.3
LSD $P \leq 0.05$		6.6	1.3

^zAbbott and Cobb, Feasterville, Pa.; Asgrow Seed Co. (Seminis Vegetable Seeds), Saticoy, Calif.; Harris Moran Seed Co., Modesto, Calif.; Petoseed (Seminis Vegetable Seeds), Saticoy, Calif.; Novartis Seeds, (formerly Rogers NK Seed Co.) Boise, Idaho; and Sakata Seed America, Morgan Hill, Calif.

^y1.0 ton/acre = 2.24 t·ha⁻¹.

^x1.0 lb = 0.45 kg.

Table 4. Head dimensions and characteristics of cabbage cultivars grown in the fall cultivar trial at Pennsylvania State University, Rock Springs, Pa., 1997.

Head shape	Cultivar	Color	Head ht (inch) ^x	Head width (inch)	Core size ^z (inch ²) ^w	Head ^y firmness
Flat/semiflat: Head height/width ratio ≤0.8	Bravo	blue-green	6.6	8.2	25.3	1.6
	Blue Ridge	blue-green	6.1	7.6	19.7	1.6
	XPH 15514	green	6.6	8.3	24.2	2.4
	XPH 15518	blue-green	6.1	8.1	18.7	2.9
Round: Head height/width 0.81 to 0.97	780	blue-green	6.5	7.4	27.2	1.0
	Blue Gem	blue-green	6.9	8.2	24.2	1.1
	Augusta	blue-green	7.1	8.0	25.0	1.1
	Discovery	green	6.8	7.4	29.1	1.1
	Blue Bayou	blue-green	6.5	8.1	26.6	1.2
	Columbia	green	7.0	7.5	21.1	1.2
	Atlantis	green	6.9	7.8	21.0	1.4
	XPH 5957	blue-green	6.9	7.8	22.2	1.4
	841	red	6.3	6.9	20.0	1.6
	XPH 15508	blue-green	7.5	7.9	18.9	1.6
	XPH 15516	blue	6.2	7.3	22.4	1.7
	Blue Thunder	blue	6.6	7.7	26.0	1.7
	XPH 15511	green	6.6	7.3	27.0	1.9
	XPH 15513	green	6.5	7.5	21.1	2.2
	XPH 15515	blue-green	7.1	7.8	28.0	2.2
	XPH 15519	blue	5.8	6.7	17.6	2.7
	Emblem	blue	7.4	8.3	37.8	2.9
	790	blue	6.4	7.8	24.5	3.3
	831 YR	dark red	6.8	6.8	33.9	1.3
	CB2	blue	7.1	7.0	22.3	1.4
Oblong: Head height/width ≥0.98	Cardinal	dark red	7.1	7.2	25.5	2.9
	CB6	green	7.3	7.4	32.3	3.8

^zDetermined by multiplying core height by core width.

^yVisually assessed on a scale of 1 to 5, with 1 being tight and 5 being loose.

^x1.0 inch = 2.54 cm.

^w1.0 inch² = 6.45 cm².

Our trial results suggest that for Pennsylvania, no single cultivar will perform best during the entire growing season, and that cultivars should be chosen based on seasonal performance. Best performing cultivars were chosen based on marketable yield as well as color, corelength, and head firmness. For spring, best performing cultivars in this trial were; 'Discovery', 'Atlantis', 'Columbia', 'CB 2', and 'Blue Ridge'. For fall, best performing cultivars in this trial were; 'Blue Gem', 'Augusta', 'Bravo', 'Blue Bayou', and 'XPH 15508'.

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