

## Cabbage Variety Trial

### In a Nutshell:

- Farmers in Iowa are curious about how heat-tolerant vegetable varieties developed on the East Coast will perform in Iowa's hot and humid summers.
- Three farms compared four cabbage varieties – Caraflex, Capture, Farao and Primo Vantage – to determine which performed best, in yield and quality, on their farms.

### Key Findings:

- Farms strongly preferred Farao and Primo Vantage; Caraflex performed well as a conical-shaped cabbage.
- Capture was a new variety, and did not perform well on any of the farms. Farmers thought perhaps this was either a bad seed year or the variety struggled with Iowa's summer heat.

### BACKGROUND

Previous PFI trials have looked at heat-tolerant varieties of broccoli and head lettuce; for 2019, the trial focus was on cabbage.<sup>[1-4]</sup> “We want to be able to give people cabbage during the summer, when people want to make coleslaw,” said Emily Fagan, one of the farmers who participated in the trial.



Emily Fagan weighing cabbages for the variety trial on July 18, 2019.

### METHODS

All farmers planted four replications of cabbage varieties in randomized, replicated trials. Varieties were selected based on farmer preference, and their suitability for summer production, based on the Johnny's catalog descriptions. Caraflex was expected to produce a smaller head (in weight), based on the varietal characteristic, and it was also the only conical-shaped variety included in the trial. Seeds for the trials were provided by Johnny's Seeds (Winslow, ME).

Production practices including mulching, spacing, irrigation, planting dates and harvest dates were determined by farm and are detailed in **Table 1**. All farmers transplanted cabbage starts during June (Fagan also transplanted a succession in May), and all cabbages were harvested by mid-August. All farmers used at least some drip irrigation, and spacing varied by farm, with Black's having the tightest spacing (**Table 1**).

Farmers collected yield data by plot, including the number of heads harvested and harvest weight. During each harvest

### Cooperators

Carmen and Maja Black, Sundog Farm, Solon

Kate Edwards, Wildwoods Farm, Iowa City

Emily Fagan, Humble Hands, Decorah

### Funding

Ceres Trust; Seed provided by Johnny's Seeds

TABLE 1. Trial design and production practices by farm.

	BLACK	EDWARDS	FAGAN
Seeding Date(s)	May 12	May 7	March 25; Apr. 22
Transplant Date(s)	June 8	June 14	May 13; June 3
Harvest Date(s)	Aug. 16	Aug. 17-18	July 16 - Aug. 20
Varieties Used	Caraflex, Farao, Primo Vantage	Caraflex, Farao, Primo Vantage	Capture, Caraflex, Farao, Primo Vantage
In-row Spacing	8 in.	12 in.	18 in.
Between-row Spacing	36 in.	36 in.	24 in.
Irrigation (Y/N), Type	Y, drip at transplant only	Y, drip	Y, drip
Mulch (Y/N), Type	N	N	N
Plot Area	24 ft <sup>2</sup>	30 ft <sup>2</sup>	36 ft <sup>2</sup>
Plants per Plot	12	10	12 (unless noted)

they also scored each plot for issues with quality, specifically: head splitting, black rot and cabbage worms. Presence of these issues in each plot were scored as “much”, “some”, or “none”. To create average scoring for quality, numerical values were substituted in the following manner: “much” = 0, “some” = 0.50, and “none” = 1.0. A score of 1.0 indicates that the farmer did not see any quality issues during harvest; scores closer to 1.0 indicate better quality. These scores were not statistically analyzed.

To determine the effect of variety on cabbage yield, we calculated Tukey’s least significant difference (LSD). If the difference in yield measurements for any two varieties was greater than or equal to the LSD, we confirm that variety had a statistically significant effect on yield. On the other hand, if the difference in any yield measurements was less than the LSD, we consider the varieties to be statistically similar. We used a 90% confidence level to calculate the LSDs, which means that we would expect our rankings to occur 90 times out of 100. We could make these statistical calculations because the farmers’ experimental designs involved replication and randomization of the three treatments (**Figure A1**).

## RESULTS AND DISCUSSION

### *Black, Solon*

Yield and percent of harvestable heads at Black’s were statistically similar among varieties (**Table 2**). This may have been due to high variation in the data resulting from only three replications of each variety. All varieties at Black’s struggled with cabbage worms, and some black rot, as shown in the photos. She noted that a Caraflex plot had the worst black rot, and one Farao plot had no black rot present. Farao, however, had the most issues with splitting heads (**Table 3**). Like the other farmers, Black seeded Capture in soil blocks, but too few germinated to include it in the trial.

### *Edwards, Iowa City*

Similar to the results at Black’s, yield among cabbage varieties were statistically similar at Edwards’ farm. Primo Vantage less reliably set heads compared to Caraflex and Farao (**Table 4**). Edwards observed a lot of variability in head size throughout the field. She suspected the

**TABLE 3. Cabbage quality scores by variety at Black’s**

VARIETY	SPLITTING	BLACK ROT
Caraflex	0.83	0.50
Farao	0.33	0.67
Primo Vantage	0.83	0.50

Quality indicators for each variety were recorded during each harvest as “much”, “some”, or “none” of the condition being present (splitting, black rot, cabbage worms). To create average scoring, numerical values were substituted in the following manner: “much” = 0, “some” = 0.50, and “none” = 1.0. A score of 1.0 indicates that the farmer did not see any quality issues during harvest; scores closer to 1.0 indicate better quality.

**TABLE 2. Cabbage yield components by variety at Black’s.**

VARIETY	HEAD HARVEST %	HEAD WEIGHT (lb)
Caraflex	87%	0.84
Farao	90%	1.65
Primo Vantage	84%	1.64
LSD	23%	1.05

By column, because values do not differ by the least significant difference (LSD), we consider them statistically similar with 90% certainty.



Harvest bins of cabbage varieties at Blacks', clockwise from top left: Primo Vantage, Farao, Caraflex. Lower left: Each variety of cabbage seedlings were planted in quadrants of soil blocks; Capture seed did not germinate.



TABLE 4. Cabbage yield components by variety at Edwards'.			
VARIETY	HEAD HARVEST %	PLOT WEIGHT (lb)	HEAD WEIGHT (lb)
Caraflex	88	9.4	1.07
Farao	98	12.1	1.23
Primo Vantage	69	8.8	1.31
LSD	30	5.4	0.57
By column, because values do not differ by the least significant difference (LSD), we consider them statistically similar with 90% certainty.			

TABLE 5. Cabbage quality scores by variety at Edwards'.			
VARIETY	SPLITTING	BLACK ROT	CABBAGE WORMS
Caraflex	0.88	0.44	0.44
Farao	0.88	0.50	0.50
Primo Vantage	1.00	0.42	0.50
Quality indicators for each variety were recorded during each harvest as “much”, “some”, or “none” of the condition being present (splitting, black rot, cabbage worms). To create average scoring, numerical values were substituted in the following manner: “much” = 0, “some” = 0.50, and “none” = 1.0. A score of 1.0 indicates that the farmer did not see any quality issues during harvest; scores closer to 1.0 indicate better quality.			



Harvest bins of cabbage varieties at Edwards', clockwise from top left: Primo Vantage, Farao, Caraflex. Lower left: Kate Edwards weighs cabbages from a trial plot.

rather uneven production was due, in part, to weed pressure. Wet soils through May prevented Edwards from transplanting an earlier succession of cabbage for the trial, and disrupted her ideal weed-management schedule. Edwards did not have much trouble with splitting heads, but did have issues with black rot and cabbage worms in all varieties (**Table 5**).

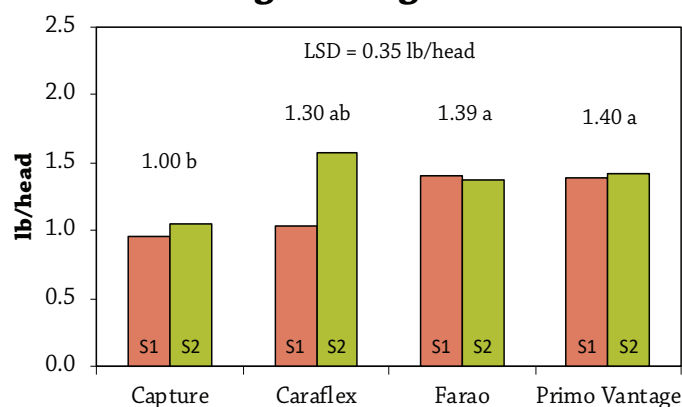
#### Fagan, Decorah

Across both successions, Primo Vantage and Farao had the statistically largest heads (1.39 and 1.40 lb/head) (**Figure 1**). Caraflex, the only conical-shaped variety included in the trial, finished in the middle, at 1.30 lb/head, and Capture resulted in the smallest heads (1.00 lb/head).

Fagan was the only farmer to successfully grow and harvest Capture, but will not grow the variety again. “Capture had problems with black rot, and set heads very, very late. Only when I went to till it in after harvesting all the other plots entirely did I realize it had heads. We ate them ourselves, but they were not of good enough quality to sell.” Farao, Primo Vantage and Caraflex from both successions were harvested between July 16 – Aug. 16; all Capture plants in all successions were harvested on Aug. 20.

Fagan’s cabbage trial had pressure from cabbage worms, which she rated as “some” or “much” incidence in all plots of Succession 1 and “much” in all plots of Succession 2 (**Table 6**). Capture struggled the most with black rot, while Caraflex and Primo Vantage scored quite well for black rot during both successions. Fagan did not have much trouble with cabbage heads splitting.

## Head Weight at Fagan's



**FIGURE 1.** Cabbage head weight at Fagan's. Columns represent succession mean. Above each set of columns is the variety mean. Results that differ by the least significant difference (LSD; 0.35 lb/head) are followed by different letter-ranking and are considered statistically different with 90% certainty. The data table with yield values and harvest % for Fagan is available in **Table A2**.

**TABLE 6.** Cabbage quality rankings by variety at Fagan's.

SUCCESION	VARIETY	SPLITTING	BLACK ROT	CABBAGE WORMS
S1	Capture	1.00	0.50	0.00
	Caraflex	1.00	0.94	0.50
	Farao	1.00	1.00	0.50
	Primo Vantage	1.00	0.92	0.50
S2	Capture	1.00	0.50	0.00
	Caraflex	0.88	0.88	0.00
	Farao	1.00	0.63	0.00
	Primo Vantage	1.00	1.00	0.00

Quality indicators for each variety were recorded during each harvest as "much", "some", or "none" of the condition being present (splitting, black rot, cabbage worms). To create average scoring, numerical values were substituted in the following manner: "much" = 0, "some" = 0.50, and "none" = 1.0. A score of 1.0 indicates that the farmer did not see any quality issues during harvest; scores closer to 1.0 indicate better quality.

## CONCLUSIONS AND NEXT STEPS

All farmers in the trial liked Farao, Primo Vantage and Caraflex; most plan to grow all three again. Edwards noted that CSA members who were not typically excited about getting cabbage were excited about getting a Caraflex (conical) cabbage. So even if it tended smaller it is worth it, for her farm.

Fagan reported that she will definitely continue growing Farao and Primo Vantage. "The quality measurements are really important to me. It doesn't matter what the cabbage weighs; if it's ugly no one will buy it."

All three farmers intend to trial more summer cabbage varieties in 2020, and are hoping drier planting conditions during May will allow them to move the trial forward a couple weeks.



Harvest bins of cabbage varieties at Fagan's, clockwise from top left: Primo Vantage, Farao, Caraflex. Lower left: Each variety of cabbage seedlings were planted in quadrants of soil blocks; capture seed did not germinate.



## APPENDIX - TRIAL DESIGN AND WEATHER CONDITIONS

REP1	REP2	REP3	REP4
Capture	Caraflex	Primo Van	Farao
Farao	Capture	Caraflex	Primo Van
Primo Van	Farao	Capture	Caraflex
Caraflex	Primo Van	Farao	Capture

**FIGURE A1.** Example of experimental design used by all famers in the trial, which included randomized replications of the varieties. This design allowed for statistical analysis of the results.

**TABLE A1.** Climate data for 2019 and historical averages.

MONTH	FAGAN: DECORAH				BLACK, EDWARDS: IOWA CITY			
	GROWING DEGREE DAYS (BASE 50 ° F)		RAINFALL (IN.)		GROWING DEGREE DAYS (BASE 50 ° F)		RAINFALL (IN.)	
	2019	AVG.	2019	AVG.	2019	AVG.	2019	AVG.
May	303	382	8.5	4.4	344	430	9.6	4.4
June	546	565	6.6	5.5	621	646	3.4	5.1
July	762	681	5.9	4.2	843	753	1.0	4.0
August	621	629	2.6	4.6	711	699	4.7	4.3

Monthly growing degree days and monthly rainfall for the current year and historical averages are reported from the nearest weather station. Climate data were accessed from the Decorah and Iowa City weather stations.<sup>[5]</sup> Historical data include years 1985-2018.) Where rainfall in 2019 was more than two inches different than the average, values are displayed in bold.

**TABLE A2.** Cabbage yield components by succession and variety at Fagan's

SUCCESION	VARIETY	HEAD HARVEST %	HEAD WEIGHT (LB)
S1	Capture	92	0.95
	Caraflex	98	1.03
	Farao	93	1.41
	Primo Vantage	98	1.38
S2	Capture	89	1.05
	Caraflex	96	1.57
	Farao	92	1.37
	Primo Vantage	97	1.42
AVG.	Capture	91	1.00 b
	Caraflex	97	1.30 ab
	Farao	93	1.39 a
	Primo Vantage	98	1.40 a
LSD		7	0.35

Statistical analysis was performed on the average of the two successions. Within columns, values followed by the same letter did not differ by more than the least significant difference (LSD) and are not statistically different with 90% certainty. Where no letters are reported, there are no statistical differences among means.

## REFERENCES

1. Kolbe, L., J. Beebout, C. Black, K. Edwards, R. Faux, J. Scheibel and J. Yagla. 2018. Summer Lettuce Variety Trial. <https://practicalfarmers.org/research/summer-lettuce-variety-trial-2/>.
2. Kolbe, L., C. Black, R. Faux, A. McGary, J. Scheibel and K. Edwards. 2017. Summer Lettuce Variety Trial. Practical Farmers of Iowa Cooperators' Program. <https://practicalfarmers.org/research/summer-lettuce-variety-trial/> (accessed April 2019).
3. Kolbe, L. and R. Faux. 2017. Summer Broccoli Variety Trial 2013-2017. <https://practicalfarmers.org/research/summer-broccoli-variety-trial-2013-2017/>.
4. Kolbe, L., J. Beebout, C. Black, R. Hartmann, A. McGary, J. Scheibel and M. Quee. 2016. Summer Broccoli Variety Trial. <https://practicalfarmers.org/research/summer-broccoli-variety-trial/>.
5. Iowa Environmental Mesonet. 2019. Iowa Environmental Mesonet. Iowa State University Department of Agronomy. <http://mesonet.agron.iastate.edu/> (accessed March 2019).



### PFI COOPERATORS' PROGRAM

PFI's Cooperators' Program helps farmers find practical answers and make informed decisions through on-farm research projects.

The Cooperators' Program began in 1987 with farmers looking to save money through more judicious use of inputs.

If you are interested in conducting an on-farm trial contact Stefan Gailans @ 515-232-5661 or [stefan@practicalfarmers.org](mailto:stefan@practicalfarmers.org).