Brussels Sprouts Variety Trial and Topping Study, 2013 & 2014

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Objectives

1) compare growth and marketable yields of several Brussels sprouts varieties
2) measure the effects of topping (removing the apical meristem) on marketable yields

Part 1. Variety evaluation

We evaluated nine (9) cultivars of Brussels sprouts in 2013 and 2014 at Woodman Farm in Durham NH (Zone 5B). Six varieties were included in both years. In 2014, we chose to drop the cultivar Falstaff and Roodnerf; Gustus was not available at the time we ordered seeds. Early Marvel seeds germinated very poorly, and therefore could not be included in the planting.

Varieties included in 2013 and 2014 experiments

Cultivar	Reported Days to Maturity	Seed Source (s)	2013	2014	Avail OG*	OP/F1*
Catskill	85	Burpee	X	X		OP
Churchill	90	Johnny's		X		F1
Diablo	110	Johnny's	X	X		F1
Doric	120	High Mowing	X	X	X	F1
Early Marvel	85	Burpee	X	X		F1
Falstaff	98	Fedco	X			OP
Gustus	99	Fedco	X			F1
Jade Cross E	85	Harris	X	X		F1
Nautic	105	Johnny's (2013), High Mowing (2014)	X	X	X	F1
Nelson	90	Johnny's		X		F1
Roodnerf	96	Fedco	X			OP
Octia	78	Burpee		X		F1

** OG = certified organic seed, OP = open-pollinated, F1 = F1 hybrid seed*

In 2013, plants were seeded on June 3, transplanted into the field on July 8, and harvested on Nov 6 (137 days post-transplant). Because some cultivars did not mature in the 2013 planting, we planted 3 weeks earlier in 2014. **In 2014**, plants were seeded in May 12, transplanted on June 6, and harvested on two different dates; half of the planting (two reps) was harvested on Oct 19 (135 days post-transplant), and the other half was harvested on Nov 18 (165 days post-transplant). Temperature and light levels were low by late fall, and there was no indication of significant differences in yield between the two harvest dates.

At harvest, all leaves were stripped and loppers were used to cut main stems. For each plot, we estimated the percentage of total sprouts unmarketable due to being too small (less than 0.75" diameter), too large or loose (over 2" diameter), or due to excessive Alternaria symptoms. We did not collect data from edge plants. For all other plants, we measured **number and weight of marketable sprouts** (0.75-2" diameter).

Cultural Details

Fertilizers were applied based on soil tests. In 2013, plots received 140 lbs/acre of N and 140 lbs/acre of K2O. In 2014, plots received 160 lbs/acre of N and 125 lbs/acre of K2O. Cultivars were planted in a randomized complete block design with four reps; twelve plants per plot. Plants were spaced 18 inches apart in a single row on 30 inch raised beds covered with black plastic embossed mulch. Plants were seeded in 98-cell plug trays into ProMix BX and transplanted into the field 3-4 weeks later. *Bacillus thuringiensis* (Dipel) was applied throughout both growing seasons to manage caterpillar pests. Cabbage aphids infested plantings in both years, but infestation was earlier and more severe in 2014. Lower leaves (the bottom third of each plant) were trimmed from all plots once in 2013 and twice in 2014, to improve air circulation.

Results and conclusions

Photos of all varieties are shown following the text of this bulletin. Varieties differed greatly in terms of number and weight of marketable sprouts per stem. For those cultivars grown in both years, performance was generally similar in both years.

Yields of Untopped Brussels Sprouts

2013					2014				
	Weight (oz.) per plant		No. Sprouts per plant			Weight (oz.) per plant		No. Sprouts per plant	
Gustus	15.0	a	30.9	ab	Jade Cross E	20.3	a	59.1	a
Early Marvel	12.5	ab	37.8	a	Octia	21.4	a	54.3	ab
Nautic	11.2	abc	28.9	ab	Nelson	16.6	ab	46.5	abc
Doric	8.5	bc	28.7	ab	Churchill	14.5	bc	38.7	bc
Diablo	8.4	c	22.9	bc	Nautic	13.9	bc	53.1	ab
Jade Cross E	8.2	c	27.3	b	Diablo	9.9	c	31.9	cd
Falstaff	2.7	d	14.1	cd	Doric	3.4	d	19.5	de
Catskill	2.0	d	8.8	d	Catskill	2.5	d	9.8	e
Roodnerf	1.8	d	7.9	d					

Values followed by the same letter are not significantly different from one another.

In 2013, **Gustus, Early Marvel and Nautic** produced the highest marketable yield (all over 11 oz per plant). Roodnerf, Catskill and Falstaff produced the lowest yields. In 2014, **Jade Cross E, Octia and Nelson** produced the highest marketable yield (all over 16 oz per plant). **Churchill and Nautic** also produced high yields, with over 13 oz per plant. Doric and Catskill produced the lowest yields.

Some cultivars' poor yields were likely due to very late development, with a high percentage of sprouts being too small (Catskill, Doric, Falstaff, Roodnerf). While Nelson and Churchill had relatively high yields (2014), both showed a high degree of lateral branching at the base of the plants, which is undesirable because it makes harvest more difficult and impedes air flow.

More Alternaria symptoms were observed in 2013 than in 2014. Three cultivars had over 20% of sprouts with symptoms rendering them unmarketable in at least one year of the trial: Gustus, Jade Cross E and Nelson. None of the cultivars with widely spaced sprouts (Catskill, Doric, Early Marvel, Falstaff, Nautic and Octia) had high levels of Alternaria, possibly because their growth habit permitted good airflow to the sprouts.

None of the open-pollinated (OP) cultivars performed well in our study. The two green cultivars (Catskill and Roodnerf) both showed a high degree of variability, including different coloring and growth habits. The purple OP cultivar Falstaff was uniform but had very low yields.

Prevalence of defects and comments on stalk quality

Cultivar	Reported days to maturity	Relative observed maturity	Too small*	Too large	Alternaria	Space between sprouts	Comments on stalk quality
Catskill	85	Late	4, 4	0, 0	0, 1	4	Highly variable
Churchill	90	Early	1	1	1	1	Lateral branching
Diablo	110	Mid	2, 3	0, 0	1, 0	2	
Doric	120	Very Late	3, 4	0, 0	0, 0	4	
Early Marvel	85	Mid	2	0	1	3	
Falstaff	98	Late	4	0	0	4	
Gustus	99	Early	1	0	2	1	
Jade Cross E	85	Early	2, 2	1, 1	2, 1	0	
Nautic	105	Mid-Late	2, 2	0, 0	1, 0	3	
Nelson	90	Early	1	2	2	2	Lateral branching
Roodnerf	96	Late	4	0	1	2	Highly variable
Octia	78	Mid-Late	1	1	0	4	

* **Ratings explained:** When two numbers are given, separated by commas, these correspond to ratings in 2013 and, 2014, respectively. Noteworthy ratings are highlighted. **Too small:** 4 = >70%, 3 = 40-70%, 2 = 20-40%, and 1 = <20% sprouts per stalk < 0.75 inch diameter. **Too large:** 2 = >15%, 1 = 5-15%, 0 = <5% sprouts per stalk > 2 inch diameter. **Alternaria:** 2 = >20%, 1 = 6-20%, 0 = <6% sprouts per stalk unmarketable due to severe symptoms. **Space between sprouts**: 4 = wide spacing between sprouts, 0 = very tightly spaced sprouts

In a nutshell. Of the five cultivars grown in both years, **Nautic**, **Diablo** and **Jade Cross E** yielded well (over 8 oz per stalk). While tall and vigorous, Doric was very late to mature, and most sprouts did not reach marketable size. Catskill was also very late, showed considerable variability in growth habit, and yielded poorly in both years.

For those cultivars evaluated in only one year, **Gustus**, **Early Marvel** and **Octia** were promising, with high yields on quality stalks. Nelson and Churchill had high yields but both showed excessive lateral branching and a tendency for bottom sprouts to become oversized. Falstaff and Roodnerf had poor yields, and Falstaff was highly variable with a number of off-type plants.

Part 2. Does topping increase marketable yields?

The theory. Sprouts of Brussels sprouts are axillary buds. Auxins produced by the apical meristem (the top growing point) of the plant inhibit the development of the axillary buds below the top of the plant. Removing the apical meristem causes the axillary buds to expand. Therefore, removing the top of the Brussels sprout plant at the right time has been shown to increase the size of the sprouts at the top of the stalk, improving marketable yields.

Topping Treatments

In each plot, half of the plants (6) were topped when lowest sprouts had started to develop, reaching 0.5-1 inch in diameter; and the other half were left un-topped. Because varieties matured at different dates, topping was performed at different dates, according to the chart below:

2013 Topping Dates		2014 Topping Dates	
10 Sept.	Diablo, Early Marvel, Gustus, Jade Cross E	4 Aug.	Jade Cross E
		14 Aug.	Churchill, Nelson
18 Oct.	Catskill, Doric, Falstaff, Nautic, Roodnerf	4 Sept.	Diablo, Nautic, Octia
		23 Sept.	Catskill, Doric

In 2014, we also chose five cultivars (Diablo, Doric, Jade Cross E, Nelson and Octia) to illustrate the effects of topping at different dates. You can see the effects of topping at different dates in the photos at the end of this bulletin.

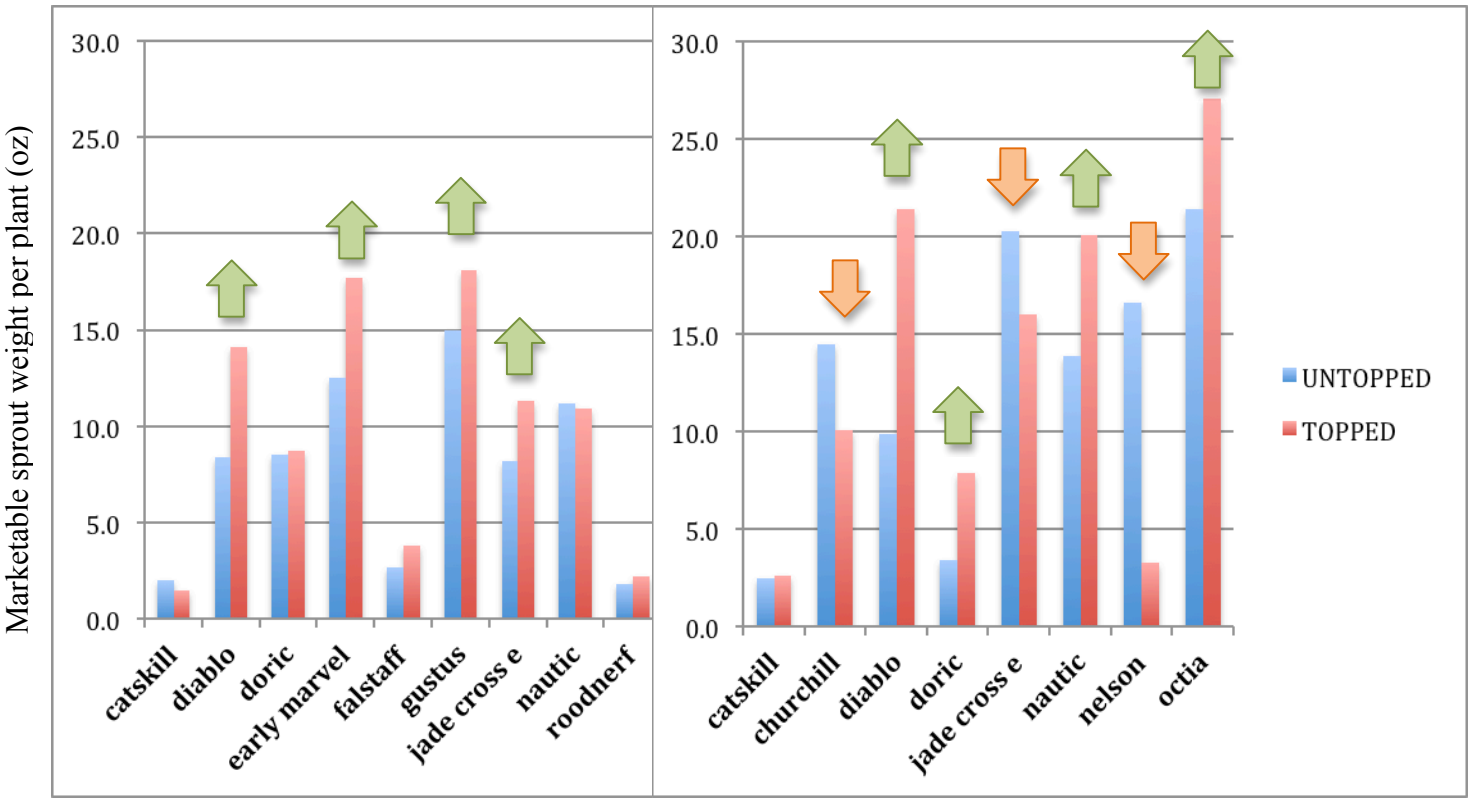
Results – Effects of Topping

For **some cultivars**, topping had the desired effect, reducing the number of sprouts that were too small, and increasing the marketable number and weight of sprouts. For those varieties that showed a higher tendency for the lower sprouts to become oversized (Nelson, Jade Cross E, Churchill and Octia, for example), topping did not alleviate this problem. The photos of each cultivar illustrate both topped and untopped stalks of each cultivar.

2013. Topping plants when the largest sprouts were 0.5-1 inch in diameter significantly improved sprout development. Topping reduced the average percentage of undersized sprouts from 51% (untopped) to 41% (topped), increased the marketable number of sprouts per stalk from 23 to 27, and increased marketable sprout weight from 7.8 to 9.8 oz per stalk.

Topping had the greatest positive effect for Diablo, Early Marvel, Gustus and Jade Cross, which were early and mid-season varieties that were ready to be topped by early September. Topping did not affect yields of Catskill, Doric, Falstaff, Nautic or Roodnerf. These varieties had very small sprouts, and were not ready to be topped until mid-October, just 19 days before harvest.

2014. In 2014, the results of topping were mixed. Yields of the early cultivars (Churchill, Jade Cross E and Nelson) were significantly reduced by topping, whereas yields of the mid- and late-season cultivars (Diablo, Doric, Nautic and Octia) were increased by topping.



Marketable weight of topped vs. untopped brussels sprouts in 2013 (L) and 2014 (R).

In 2014, with the exception of Catskill, the mid- and late-season cultivars (which were topped in September, 24-75 days before harvest) showed a yield increase due to topping. In contrast, early-maturing cultivars that were topped in August when lower sprouts were 0.5-1 inch in diameter (64-106 days before harvest) continued to grow vigorously. As a result, these plants branched and generated whole new stalks (evident in photos of topping dates experiment). The new stalks formed sprouts, but they remained tiny and did not develop. Ultimately, topping these early varieties (Jade Cross E, Nelson, and Churchill) reduced marketable yields of sprouts, and rendered whole stalks unmarketable because of their forked shape. It is important to note that, because these varieties matured early, they could have been harvested in mid-September rather than mid-November, but we chose not to harvest at different dates because of potential impact on yield. Further, we felt that most growers would primarily market sprouts in late fall, after a frost.

Different topping dates. For those varieties where we topped at different dates, photos of the results are shown on the last three pages of this bulletin. For all varieties, topping more than 75 days pre-harvest (even if sprouts were already at marketable size) was

counterproductive, reducing stalk height and, in may cases, causing the tops to branch. Topping 75 dph was helpful for some varieties. Later topping might also have been beneficial, but we did not include later topping dates.

Conclusions. The practice of topping has the potential to increase yields of Brussels sprouts, assuming a once-over harvest. It can also increase the attractiveness of a full harvested stalk, if growers are marketing entire stalks. However, topping too far in advance of harvest can reduce yields and marketability by causing plants to spend energy growing new stalks.

In California, Brussels sprouts destined for once-over mechanical harvest are typically topped 50-60 days before harvest (National IPM Center Crop Profile, 1999). From our study, it would appear that topping somewhere between 24-75 days before harvest could be beneficial. Topping more than 60-85 days before harvest, even if lower sprouts have reached marketable size, was counterproductive and reduced yields.

Further study would be needed with specific varieties using different planting and harvest dates to determine the optimum range of topping and harvest dates. Recommending topping at a specific number of days before harvest is complicated by the fact that plant growth slows tremendously in the fall. As a result, a certain number of days in late summer or early fall results in much more growth response than the same time period in mid- or late fall.

In the past, we have suggested that topping should be done based on the physiological development of the plant, for example when the largest sprouts are 0.5-1” diameter, rather than on a specific date. Our current thinking is that topping between 30-60 days before harvest, especially once lower sprouts have begun to reach marketable size, will result in the maximum benefit to marketable yields and appearance of Brussels sprouts. If you do not plan to harvest sprouts for at least 60 days, hold off on topping to allow plants to continue to grow.

For additional information, please contact Becky Sideman (becky.sideman@unh.edu, 603-862-3203) or Olivia Saunders (olivia.saunders@unh.edu).

Catskill (2013)

Churchill (2014)

Diablo (2013)

Doric (2013)

Doric (2014)

Early Marvel (2013)

Falstaff (2013)

Gustus (2013)

Jade Cross E (2013)

Jade Cross E (2014)

Nautic (2013)

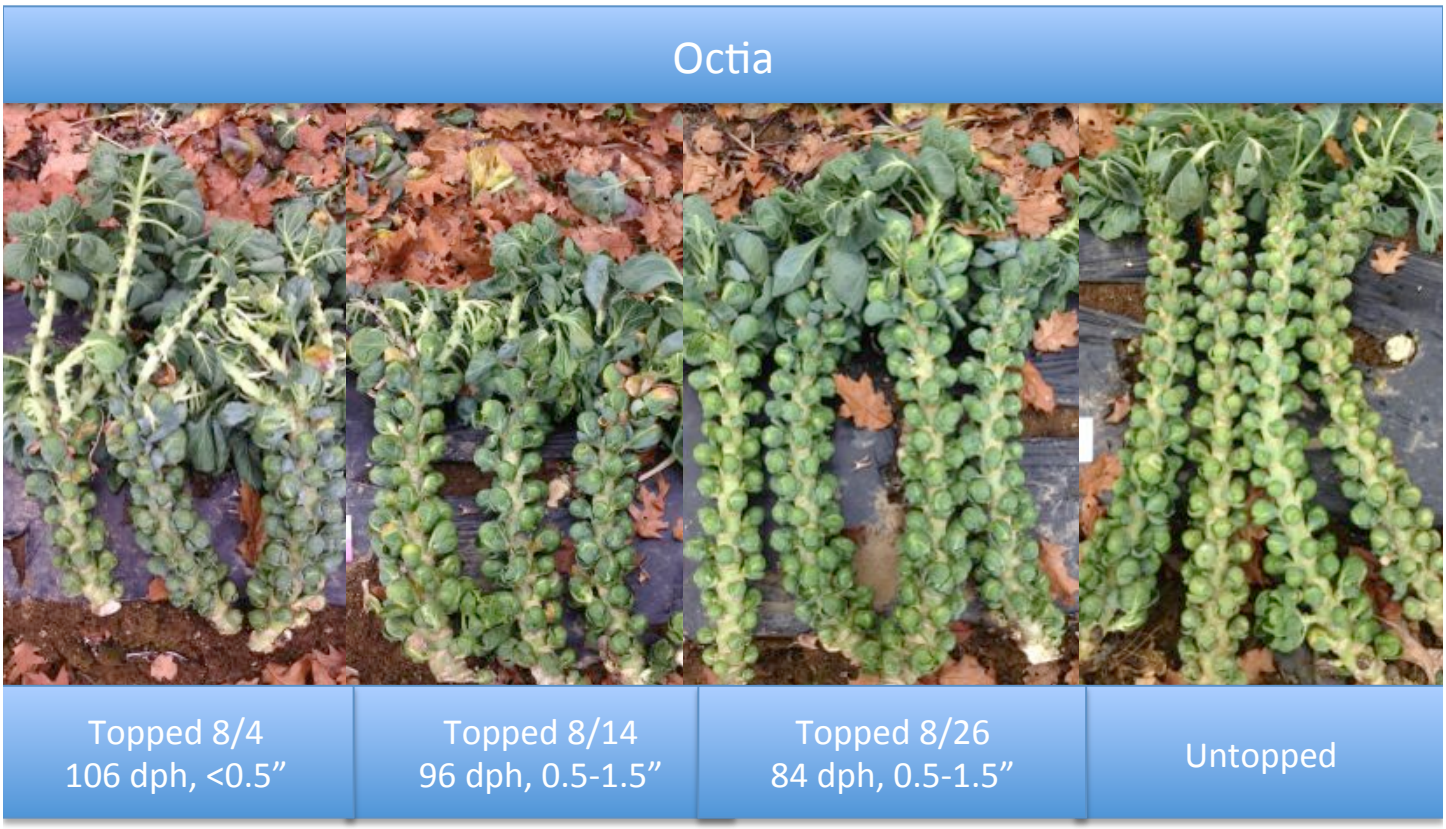
Nautic (2014)

Nelson (2014)

Roodnerf (2013)

Octia (2014)

Effects of topping brussels sprouts at different dates



For each topping date, the number of days pre-harvest (dph) and size (diameter) of sprouts at the time of topping is given. All data collected on 11/18.

Data for Octia	Topped 8/4	Topped 8/14	Topped 8/26	Un-Topped
# sprouts/ plant	28.5	38.5	52.3	68.2
Yield (g)/plant	432.3	637.6	812.3	766.0
% too small	*1.7*	*0*	*0*	*10.0*
% too large	*13.3*	*14.0*	*9.0*	*1.7*
% alternaria	*21.7*	*11.0*	*9.3*	*10.7*

Results: For Octia, number and weight of marketable sprouts were highest for un-topped stalks and those topped at the latest date (8/26). We didn’t collect yield data for the other varieties, but the photos show similar results.

Nelson

Topped: 8/4 106 dph Sprout size: 1-1.5”	8/14 96 dph >1.5”	8/26 84 dph >1.5”	Untopped

For each topping date, the number of days pre-harvest (dph) and size (diameter) of sprouts at the time of topping is given. All data collected on 11/18.

Doric

Topped: 8/4 106 dph <0.5”	8/14 96 dph <0.5”	8/26 84 dph 0.5-1“	9/4 75 dph 0.5-1”	Untopped

Diablo

Topped: 8/4 106 dph <0.5”	8/14 96 dph <0.5”	8/26 84 dph 0.5-1”	Topped 9/4 75 dph 1-1.5”	Untopped

For each topping date, the number of days pre-harvest (dph) and size (diameter) of sprouts at the time of topping is given. All data collected on 11/18.

Jade Cross E

Topped: 8/4 106 dph 1-1.5”	8/14 96 dph >1.5”	8/26 84 dph >1.5”	9/4 75 dph >1.5”	Untopped