

Comparing Broccoli Cultivars in Late Spring Planting

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Introduction

Broccoli is a popular and lucrative crop grown on several organic vegetable farms in Iowa. A member of the *Brassicaceae* family, broccoli is a cool-season crop, with an ideal growing temperature being 60-65°F. Vegetable growers in Iowa normally transplant spring broccoli in mid- to late-April, giving time for the broccoli to grow in the cooler temperatures of spring and avoiding the highest temperatures of the summer. High temperatures often lead to early bolting, increased disease incidence, and a high rate of unmarketable heads. In the spring, it can be difficult to predict when high temperatures will occur and being one of the busiest seasons on a farm, other events may limit a grower's ability to transplant broccoli at the ideal time. Growers also might have a desire to extend their broccoli harvest and sales later in the summer.

The objective of this study was to identify broccoli cultivars that could be transplanted late spring and would perform well, irrespective of early summer high temperatures.

Materials and Methods

Broccoli cultivars were selected for being the most popular cultivars grown on Iowa vegetable farms and for their described heat tolerance by seed suppliers. Six broccoli cultivars—Belstar (High Mowing, LLC), Covina (High Mowing, LLC), Emerald Crown (Johnny's, LLC), Green Magic (Johnny's,

LLC), Gypsy (Johnny's, LLC), and Imperial (Johnny's, LLC) were seeded at the Department of Horticulture greenhouses March 17, 2020.

Shortly after seeding, Iowa State University experienced closures and delays in response to COVID-19. This resulted in an inability to transplant the broccoli to the field at the ideal time, creating an opportunity for this study. Broccoli was transplanted to the field May 12, 2020.

The study was conducted on certified organic land at the ISU Horticulture Research Station, Ames, Iowa. Before transplanting, based on soil test results, compost was applied at the rate of five tons/acre followed by broadcasting and incorporating Sustane Natural Fertilizer (4-6-4), Inc. (Cannon Falls, MN).

The study consisted of six plots and each plot was 30 ft x 30 ft. Each cultivar was grown in one row/plot with one row of Virgo (Seedway, LLC) broccoli cultivar on each side of the plot as a guard row. The Virgo broccoli data was not included in the study. Broccoli rows were spaced at 36 in., center to center, and plant spacing was 12 in. in a row, for a total of 25 plants/row. With six replications, the total number grown for each cultivar was 150 broccoli plants.

The crop was irrigated with drip irrigation and hand weeded as needed. The plants were monitored for pest and disease incidence in accordance with organic crop management guidelines.

Broccoli harvest began July 2 and occurred weekly until the final harvest August 8, for a

total of seven harvests. The harvested broccoli heads were categorized as marketable or non-marketable. The number and weight of marketable heads for each cultivar was recorded. Total head diameter of all marketable broccoli heads was measured for each cultivar at each harvest. This was converted to an average diameter/marketable head for each cultivar. Non-marketable heads were categorized by the presence of yellow eyes, brown discoloration, loose head, beading, and bolting. The number and weight of heads in each non-marketable category was recorded.

Results and Discussion

Broccoli marketable yield. There was no statistically significant difference among the different cultivars for the number or weight of marketable heads/plot, ranging from 9-17 heads, weighing between 1.2-2.6 kg (Table 1). Belstar produced the lowest number (9) and lowest weight (1.2 kg) of marketable heads/plot (Table 1). Green Magic and Covina produced the largest number of marketable heads/plot, 17 and 16, respectively, both with a weight of marketable heads/plot reaching 2.3 kg (Table 1). Imperial produced the largest weight of marketable heads/plot with 2.6 kg, from 14 heads, with the highest average weight/head of 186 kg.

Average head diameter. Head diameter of marketable broccoli heads was not significantly different between cultivars. Imperial produced heads with the largest average diameter of 10.1 cm (Table 2). Gypsy produced the smallest average head diameter, 8.5 cm.

Non-marketable broccoli. There was no statistically significant difference among cultivars for the number and weight of non-

marketable heads/plot. Broken down into non-marketable categories, statistically significant differences between cultivars were found. Gypsy had significantly more brown discoloration than all other cultivars, with an average of three heads/plot (Table 1). Covina was the only cultivar to experience beading of the heads, with an average of one head/plot (Table 1). Emerald Crown and Covina heads had the most yellow eyes, with 2.8 and 2.3 heads/plot, respectively, but no significant difference between cultivar was present (Table 1). Belstar heads bolted significantly more than the other cultivars, with 5.3 heads/plot (Table 1).

Temperature. In the early season, from May 12 through June 9, average daily high temperature was 76.7°F (Table 3). In the mid season and late season, June 10-July 8, and July 9-August 6, respectively, average daily high temperatures increased to 85°F and 84.5°F, respectively (Table 3).

Peak production. Belstar and Imperial broccoli heads reached peak production later than other cultivars, with the highest number of heads harvested/plot occurring July 31, the sixth harvest (Table 4). Green Magic and Gypsy were the earliest cultivars to reach peak production, with the highest number of heads harvested occurring on the first two harvests, July 2 and July 8. Covina reached peak production in the middle of the season, with the highest number of heads harvested occurring July 20. Emerald Crown held a steady yield throughout the first four harvests, with 17-20 heads harvested each week July 2-July 20. All other cultivars experienced a quick peak of number of marketable heads, lasting only one or two harvests. This information can be useful to Iowa growers seeking to use cultivar selection in a

succession plan for late-season planting for continuous harvest from a broccoli planting.

Belstar, with the lowest number and weight of marketable heads and a significantly higher rate of bolting heads, performed the lowest in the cultivar trial and is the least suitable for late-season planting in Iowa. Imperial produced the largest number and weight of marketable heads but did not reach harvestable size until the last two weeks of the trial. Covina was a top producer of marketable heads but suffered high rates of beading and yellow eyes. Green Magic appears to be the most suitable to late season planting,

producing the largest number of marketable heads and experiencing low rates of non-marketability.

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Table 1. Broccoli yield/plot at the Horticulture Research Station, Ames, IA, from the 2020 growing season.

| Cultivar | Marketable | | Non-marketable | | Loose head | Beading | Brown discoloration | Yellow eyes | Bolting |
|---------------|------------|-------------|----------------|-------------|------------|---------|---------------------|-------------|--------------------|
| | No. | Weight (kg) | No. | Weight (kg) | No. | No. | No. | No. | No. |
| Belstar | 9 | 1.2 | 9 | 0.9 | 3.5 | 0 b | 0 b | 0.3 | 5.3 a ^z |
| Covina | 16 | 2.3 | 8 | 1.2 | 2.7 | 1 a | 1 b | 2.3 | 0.7 b |
| Emerald Crown | 14 | 2.0 | 9 | 1.6 | 4.8 | 0 b | 1 b | 2.8 | 0 b |
| Green Magic | 17 | 2.3 | 7 | 1.4 | 5.0 | 0 b | 1 b | 0.7 | 0 b |
| Gypsy | 15 | 1.9 | 9 | 1.2 | 3.7 | 0 b | 3 a | 1.3 | 0.3 b |
| Imperial | 14 | 2.6 | 7 | 1.4 | 4.2 | 0 b | 0 b | 0.3 | 2.2 b |
| P-value | 0.1101 | 0.0964 | 0.8769 | 0.6178 | 0.6660 | 0.0026 | 0.0084 | 0.1123 | 0.0002 |

^z Means within a column with the same letters are not statistically different ($P < 0.05$).

Table 2. Average head diameter of broccoli cultivars.

| Cultivar | Head diameter (cm) |
|---------------|--------------------|
| Belstar | 9.5 |
| Covina | 9.4 |
| Emerald Crown | 9.5 |
| Green Magic | 8.9 |
| Gypsy | 8.5 |
| Imperial | 10.1 |
| P-value | 0.4541 |

Table 3. Air temperatures (°F) during the growing period at the ISU Horticulture Research Station, Ames, IA.

| | Early season* | Mid season** | Late season*** |
|---------|----------------------|---------------------|-----------------------|
| Minimum | 57.7 | 72.7 | 73.5 |
| Maximum | 93.7 | 93.6 | 93.2 |
| Average | 76.7 | 85.0 | 84.5 |

*Early season: May 12-June 9.

**Mid season: June 10-July 8.

***Late season: July 9-August 6.

Table 4. Number of marketable heads/cultivar by harvest date (total from all six replications).

| Cultivar | July 2 | July 8 | July 14 | July 20 | July 24 | July 31 | Aug 8 |
|-----------------|---------------|---------------|----------------|----------------|----------------|----------------|--------------|
| Belstar | 0 | 0 | 3 | 8 | 0 | 42 | 1 |
| Covina | 0 | 10 | 35 | 37 | 11 | 0 | 0 |
| Emerald Crown | 17 | 20 | 18 | 18 | 3 | 3 | 0 |
| Green Magic | 43 | 40 | 11 | 2 | 0 | 0 | 0 |
| Gypsy | 23 | 32 | 21 | 5 | 2 | 2 | 0 |
| Imperial | 7 | 0 | 0 | 4 | 4 | 34 | 31 |