

# **Planting Date and Genotype Effects on Fresh Market/Slaw and Kraut Cabbage Yield and Head Traits in Ohio in 2002**

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## **Introduction**

Cabbage production is a large and vital part of the Ohio vegetable industry, especially in the northwest and south-central regions of the state. Strict market quality standards and Ohio's long cabbage season (late March-mid November) requires that growers select varieties not only desired by the market but also adapted to a wide range of environmental and production conditions. This project was undertaken to provide Ohio growers with information that they can employ in variety selection. This information may also help to improve our understanding of genotype and environment effects on cabbage yield and quality.

## **Materials and Methods**

Transplant Production. Entries were solicited from cooperating seed companies in winter 2001-2002. Transplants were seeded in spring, allowed to develop 2-4 true leaves in the greenhouse, and hardened-off before planting into the field.

Plot Establishment. A randomized complete block design was used in each study. Each study contained four replications per entry per planting and two planting dates (May 28 and June 25). The fresh market/sl原因 study included fifteen genotypes and the kraut study included seven genotypes. Two-row plots were established with a Holland finger transplanter. Each row was 15 ft. long with 30 in. between rows and 11 in. (fresh market/sl原因) and 18 in. (kraut) between transplants. A 150 lb. of 18-46-0 fertilizer was used to supply N and P<sub>2</sub>O<sub>5</sub>, 350 lb. of 0-0-60 fertilizer was used to supply K<sub>2</sub>O, and 125 lb. of 45-0-0 fertilizer was broadcast to supply additional N on May 5, 2002 and later incorporated before planting. A nutrient starter solution (0.7 qt. 10-34-0/50 gal. water) was delivered next to the transplants.

Plot Maintenance. Dead transplants were replaced (if possible) within one week of initial planting. Standard pest management strategies based on scouting, thresholds, and applications of labeled pesticides were employed. Overhead irrigation (1.5 in.) was applied to both studies on July 15, 2002.

Data Collection (at Harvest). Harvest readiness for individual entries was estimated from published maturity information and visual examination of the four plots per entry. At maturity, all heads were collected from within the center 10 ft. of both rows in each plot. Heads were scored as marketable or unmarketable (too small, split, rotten, or containing evidence of blackrot or tipburn) and weighed as a group. Five marketable heads were then selected at random from the harvested group for further evaluation. Five outer leaves were removed from each head before they were re-weighed individually. Heads were then cut in half longitudinally and the core length and base width as well as the head polar and equatorial diameters of each head were recorded. Half of the head was then cut longitudinally a second time with a quarter head weighed, dried, and re-weighed for percent dry weight calculation.

Statistical Analysis. Head density was estimated through calculation using head weight and average diameter values. Likewise, the percent of the head volume contained in the core was estimated through calculation using head average diameter and core length and base width. Replicate averages were calculated and used in means analysis. Main effects and interactions of planting date, entry, and replicate were analyzed with fully specified model statements in SAS ( $\alpha = 0.05$ ). Fisher's Least Significant Difference test ( $\alpha = 0.05$ ) was used to analyze the effect of planting date, replicate and genotype.

## **Results**

Both Studies. The planting date-x-genotype interaction was significant ( $\alpha = 0.05$ ) for the majority of head and core traits (Tables 2, 7). Core volume tended to be slightly less than 1% of head volume and less in June than May-planted crops (Tables 3, 8). Planting on May 28 versus June 25 tended to result in smaller and lighter heads with larger cores.

Fresh Market/Slaw Study. Data are contained in Tables 2-6. Marketable yield was greater in June-versus May-planted crops (Table 3). Marketable yield in the May planting ranged from 7.7 ton/A to 24.6 ton/A and from 14.2 ton/A to 33.3 ton/A in the June planting (Table 4). Average head weight ranged from 1130 g (2.5 lb) to 1983 g (4.4 lb) in the May planting and from 1556 g (3.4 lb) to 2660 g (5.9 lb) in the June planting (Table 5, 6). Average head density ranged from 0.670 g/cm<sup>3</sup> to 0.953 g/cm<sup>3</sup> in the May planting and from 0.592 g/cm<sup>3</sup> to 0.900 g/cm<sup>3</sup> in the June planting (Table 5, 6).

Kraut Study. Data are contained in Tables 7-11. Marketable yield in the May planting ranged from 15.7 ton/A to 26.7 ton/A (Table 9). Marketable yield in the June planting ranged from 26.5 ton/A to 41.0 ton/A (Table 9). Average head weight ranged from 1760 g (3.9 lb) to 2485 g (5.5 lb) in the May planting and from 2193 g (4.8 lb) to 3790 g (8.3 lb) in the June planting (Table 11, 12). Average head density ranged from 0.740 g/cm<sup>3</sup> to 0.857 g/cm<sup>3</sup> in the May planting and from 0.797 g/cm<sup>3</sup> to 0.897 g/cm<sup>3</sup> in the June planting (Table 11, 12).

Table 1. Number of days to harvest (DTH) for twenty-two genotypes of fresh market/slaw- and kraut-type cabbage planted on May 28 and June 25, 2002 at the OSU Vegetable Crops Research Branch in Fremont, OH.

Study	----- Entry -----		Company	May 28	June 25
	Name	#		DTH	DTH
<b>Fresh Market/Slaw</b>					
	Artost	1	BE	69	84
	ATX-151	2	AT	62	63
	BC99042	3	R	99	100
	Blue Lagoon	4	ST	70	84
	Bravo	5	HM	90	100
	Bronco	6	BE	90	100
	Charmed Dynasty	7	SM	70	84
	Golden Dynasty	8	SM	70	93
	GZG 239	9	RZ	112	107
	HMX (BAX-316) Savoy	10	ST	99	93
	HMX 0228	11	HM	83	93
	Matsumo	12	BE	90	93
	Rotunda	13	BE	90	93
	Red T-690	14	AT	83	79
	Thomas	15	BE	83	107
<b>Kraut</b>					
	Geronimo	1	BE	91	107
	Hinova	2	BE	112	107
	HMX 0221	3	HM	107	107
	HMX 0222	4	HM	107	113
	HMX 0224	5	HM	107	107
	Oriental Supercross	6	TS	91	93
	Octoking	7	VL	91	100



Table 4. Average yield of fifteen genotypes of fresh market/slaw-type cabbage planted on May 28 and June 25, 2002 at the OSU Vegetable Crops Research Branch in Fremont, OH.

Entry	#	Planting Date			
		5/28/2002		6/25/2002	
Name		total	marketable	total	marketable
Artost	1	25.4	23.0	31.6	27.1
ATX-151	2	19.4	15.6	25.6	19.9
BC99042	3	24.8	11.2	28.0	23.6
Blue Lagoon	4	17.2	7.7	25.0	18.0
Bravo	5	29.4	22.9	33.3	27.2
Bronco	6	24.7	12.6	34.3	28.3
Charmed Dynasty	7	18.4	9.0	28.4	14.2
Golden Dynasty	8	25.7	23.1	41.7	25.7
GZG 239	9	32.0	18.6	37.1	33.3
Savoy	10	25.8	16.1	25.6	23.7
HMX 0228	11	27.8	22.8	30.7	22.2
Matsumo	12	31.3	24.6	38.3	29.3
Rotunda	13	28.8	22.9	32.6	29.9
Red T-690	14	23.0	15.7	22.5	15.0
Thomas	15	23.7	17.0	35.1	32.4
CV		19.7	40.0	19.2	33.2
Pr > F		**	**	**	**
LSD <sub>(0.05)</sub>		7.06	9.97	8.58	11.64

\*\* denotes significance at alpha = 0.05.

Table 5 and 6. Head and core traits for fifteen genotypes of fresh market/slaw-type cabbage planted on May 28 (top) and June 25 (bottom), 2002 at the OSU Vegetable Crops Research Branch in Fremont, OH.

May 28, 2002		----- Head -----					----- Core -----			
----- Entry -----		weight (g)	density (g/cm <sup>3</sup> )	----- diameter -----		height/ width ratio	length (cm)	base width (cm)	percent of head volume	percent dry weight
Name	#			polar (cm)	equatorial (cm)					
Artost	1	1348	0.825	14.5	14.6	0.99	5.2	3.1	0.78	5.1
ATX-151	2	1188	0.670	15.6	14.4	1.09	4.8	3.0	0.63	-----
BC99042	3	1625	0.798	16.0	15.4	1.04	5.8	3.1	0.73	7.2
Blue Lagoon	4	1179	0.808	14.2	13.9	1.02	5.4	3.1	0.94	5.5
Bravo	5	1825	0.834	15.2	16.9	0.90	6.5	3.5	0.94	7.4
Bronco	6	1678	0.902	14.8	15.7	0.94	5.6	4.0	1.24	7.0
Charmed Dynasty	7	1130	0.764	15.0	13.3	1.13	5.1	3.7	1.21	6.5
Golden Dynasty	8	1638	0.767	15.9	16.0	1.00	5.9	3.3	0.81	4.9
GZG 239	9	1983	0.727	18.0	16.5	1.09	6.6	3.8	0.91	8.0
Savoy	10	1375	0.693	14.0	17.1	0.83	7.1	3.1	0.90	7.3
HMX 0228	11	1753	0.953	15.1	15.7	1.00	6.3	3.1	1.10	4.9
Matsumo	12	1790	0.904	14.0	17.2	0.82	4.8	3.4	0.79	5.4
Rotunda	13	1733	0.750	16.1	16.6	0.97	7.5	3.2	0.87	6.9
Red T-690	14	1403	0.899	14.8	14.8	0.94	5.8	3.0	0.89	5.7
Thomas	15	1563	0.777	15.5	15.5	1.02	7.3	3.5	1.16	6.4
CV		12.5	5.5	4.5	4.2	3.8	10.0	5.7	11.5	8.7
Pr > F		***	***	***	***	***	***	***	***	***
LSD (0.05)		275.1	0.6270	0.98	0.93	0.054	0.85	0.27	0.148	0.80
June 25, 2002		----- Head -----					----- Core -----			
----- Entry -----		weight (g)	density (g/cm <sup>3</sup> )	----- diameter -----		height/ width ratio	length (cm)	base width (cm)	percent of head volume	percent dry weight
Name	#			polar (cm)	equatorial (cm)					
Artost	1	1953	0.756	17.0	16.8	1.02	6.0	3.3	0.66	5.8
ATX-151	2	1635	0.592	17.9	16.8	1.07	5.5	3.1	0.51	4.9
BC99042	3	1863	0.855	16.1	16.0	1.01	5.7	3.3	0.73	7.4
Blue Lagoon	4	1783	0.814	16.3	15.8	1.03	6.5	3.3	0.84	6.2
Bravo	5	2660	0.859	17.2	19.0	0.91	6.7	3.5	0.68	6.8
Bronco	6	2185	0.840	17.3	16.7	1.04	5.8	3.9	0.88	7.4
Charmed Dynasty	7	1815	0.705	18.3	15.6	1.18	7.1	3.6	0.96	6.1
Golden Dynasty	8	2285	0.772	17.8	17.9	0.99	7.7	3.0	0.61	5.3
GZG 239	9	2293	0.743	18.5	17.6	1.05	6.6	3.5	0.69	7.6
Savoy	10	1556	0.655	14.7	18.4	0.80	8.4	2.7	0.69	6.9
HMX 0228	11	2162	0.808	16.9	17.5	0.97	7.5	2.9	0.61	5.9
Matsumo	12	2440	0.900	15.5	19.0	0.82	5.4	3.4	0.60	5.5
Rotunda	13	2281	0.798	17.3	17.9	0.97	7.9	2.9	0.62	6.3
Red T-690	14	1643	0.830	15.3	15.8	0.97	6.0	3.0	0.70	6.6
Thomas	15	2300	0.823	17.6	17.3	1.02	7.5	3.5	0.88	7.6
CV		10.5	5.0	3.5	4.2	3.8	8.8	5.7	11.9	5.2
Pr > F		***	***	***	***	***	***	***	***	***
LSD (0.05)		311.1	0.0568	0.86	1.04	0.054	1.04	0.27	0.123	0.48

\*\*\* denotes significance at alpha = 0.01.

Table 7. Analysis of variance results for an experiment studying the impact of planting date and genotype on kraut-type cabbage yield and head traits in Ohio in 2002.

Source	Yield (ton/A)		Head				Core			
	total	marketable	weight (g)	density (g/cm <sup>3</sup> )	diameter		length (cm)	base width (cm)	percent of head volume	percent dry weight
					polar (cm)	equatorial (cm)				
	Pr > F									
Planting Date (PD)	<0.0001	<0.0001	<0.0001	0.0170	<0.0001	<0.0001	0.0115	0.8955	<0.0001	0.0186
Genotype (G)	0.0002	0.0045	<0.0001	0.0097	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
PD x G	0.6000	0.8018	0.1063	0.0223	0.0050	0.3481	0.0011	0.1952	0.0772	0.0145

Table 8. Influence of planting date on yield and head traits for seven genotypes of kraut-type cabbage planted on May 28 and June 25, 2002 in Ohio.

Planting Date	Yield (ton/A)		Head				Core			
	total	marketable	weight (g)	density (g/cm <sup>3</sup> )	diameter		length (cm)	base width (cm)	percent of head volume	percent dry weight
					polar (cm)	equatorial (cm)				
5/28/02 (N=28)	27.2 b	21.4 b	2091 b	0.82 b	16.4 b	17.2 b	6.1 b	3.6 a	0.828 a	7.5 a
6/25/02 (N=28)	36.4 a	31.6 a	2899 a	0.85 a	17.6 a	19.5 a	6.4 a	3.6 a	0.661 b	7.2 b
LSD <sub>(0.05)</sub>	3.05	3.77	211.5	0.020	0.40	0.70	0.28	0.10	0.0502	0.28

Table 9. Average yield of seven genotypes of kraut-type cabbage planted on May 28 and June 25, 2002 at the OSU Vegetable Crops Research Branch in Fremont, OH.

Entry		Planting Date			
		5/28/2002		6/25/2002	
Name	#	total	marketable	total	marketable
Geronimo	1	27.4	24.4	41.6	28.5
Hinova	2	22.6	15.7	30.0	28.2
HMX 0221	3	24.3	16.9	31.0	28.7
HMX 0222	4	30.3	25.5	35.9	32.5
HMX 0224	5	23.7	15.9	30.2	26.5
Oriental Supercross	6	30.4	24.8	42.3	35.9
Octoking	7	31.6	26.7	43.1	41.0
CV		19.8	39.2	16.3	19.4
Pr > F		NS	NS	**	**
LSD <sub>(0.05)</sub>		7.91	11.40	8.71	9.01

Table 10 and 11. Head and core traits of seven genotypes of kraut-type cabbage planted on May 28 (top) and June 25 (bottom), 2002 at the OSU Vegetable Crops Research Branch in Fremont, OH.

May 28, 2002		Head				Core				
Entry		weight (g)	density (g/cm <sup>3</sup> )	diameter		height/ width ratio	length (cm)	base width (cm)	percent of head volume	percent dry weight
Name	#			polar (cm)	equatorial (cm)					
Geronimo	1	2165	0.848	16.0	17.7	0.91	5.8	3.5	0.74	6.3
Hinova	2	1760	0.842	16.3	15.3	1.08	7.2	3.2	0.91	9.1
HMX 0221	3	1865	0.835	16.8	15.6	1.08	6.1	3.8	1.02	8.8
HMX 0222	4	2250	0.816	17.6	17.2	1.02	5.5	3.9	0.81	8.0
HMX 0224	5	1850	0.836	16.6	15.6	1.06	6.0	3.9	1.07	8.3
Oriental Supercross	6	2485	0.857	12.9	22.2	0.58	6.3	3.5	0.71	5.7
Octoking	7	2263	0.740	18.7	17.0	1.11	5.7	3.2	0.52	6.4
CV		16.2	4.2	4.1	6.7	4.2	7.9	4.1	10.2	8.7
Pr > F		NS	**	***	***	***	**	***	***	***
LSD <sub>(0.05)</sub>		501.6	0.0511	1.00	1.73	0.061	0.71	0.22	0.126	0.80

June 25, 2002		Head				Core				
Entry		weight (g)	density (g/cm <sup>3</sup> )	diameter		height/ width ratio	length (cm)	base width (cm)	percent of head volume	percent dry weight
Name	#			polar (cm)	equatorial (cm)					
Geronimo	1	2973	0.865	18.0	19.4	0.93	6.3	3.5	0.61	7.2
Hinova	2	2193	0.875	16.9	16.8	1.01	6.5	3.1	0.67	8.3
HMX 0221	3	2618	0.880	17.6	18.1	0.98	6.6	4.0	0.94	7.7
HMX 0222	4	2678	0.897	17.3	18.2	0.96	5.0	4.1	0.74	8.0
HMX 0224	5	2438	0.839	17.4	17.6	1.00	6.0	3.6	0.75	7.7
Oriental Supercross	6	3790	0.797	15.7	25.9	0.61	7.6	3.4	0.50	5.3
Octoking	7	3605	0.828	20.4	20.3	1.01	6.8	3.2	0.42	6.4
CV		12.5	5.6	3.7	5.5	4.7	8.0	6.1	14.1	6.8
Pr > F		***	NS	***	***	***	***	***	***	***
LSD <sub>(0.05)</sub>		538.0	0.0715	0.97	1.60	0.064	0.77	0.32	0.139	0.73

NS, \*\*, \*\*\* denote not significant and significant at alpha = 0.05 and 0.01, respectively.