The Connecticut Agricultural Experiment Station, New Haven

Broccoli and Cauliflower Trials — 1986

BY DAVID E. HILL

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Broccoli and cauliflower have increased in popularity during the past decade as consumers have heeded reports by nutritionists and the American Medical Association that eating members of the genus Brassica is beneficial. Compared to most vegetables, broccoli is rich in vitamins A, B, and C, minerals and fiber. Cauliflower is similar nutritionally except in vitamin A (Anon. 1971).

This increased popularity is seen in recent statistics (Anon. 1985). Since 1974, the acreage of both crops has more than doubled in the United States. Production of broccoli for the fresh market increased from 79,500 tons in 1974 to 337,850 tons in 1984, a four-fold increase. Production of broccoli for processing increased from 100,250 tons in 1974 to 177,090 tons in 1984, a 75% increase. The national average yield is 4.0 tons/acre.

Production of cauliflower for the fresh market increased from 77,650 tons in 1974 to 235,600 tons in 1984, a three-fold increase. Production for processing increased from 74,000 tons in 1974 to 93,560 tons in 1984, a 26% increase. The national average yield is 5.4 tons/acre.

The increased demand prompted two supermarket chains to become keenly interested in Connecticut-grown broccoli, which fostered the "Broccoli Project" in 1985. In 1985, the Connecticut Department of Agriculture enlisted five growers, who grew a fall crop on 8 acres. In 1986, 13 growers raised 61 acres.

The Connecticut Agricultural Experiment Station's role in the Project was testing cultivars (cultivated varieties) from domestic seed companies to determine those best suited to Connecticut's soil and climate. In 1985, I tested 28 named and four experimental broccoli cultivars and found seven in the spring and five in the fall that consistently produced good quality heads (Hill 1986).

In 1986, I retested 13 promising broccoli cultivars and added six new cultivars and seven experimental varieties from California for a total of 26. Because discussions began this year about a companion "Cauliflower Project" in 1987, I also began testing cauliflower cultivars. I tested 10 named cultivars in the spring of 1986 and added seven more, including two experimentals, in the fall.

In this bulletin I report yields, quality, and maturity of 26 broccoli cultivars and 10 to 17 cauliflower cultivars grown at Mt. Carmel and Windsor in the spring and fall of 1986.

SITES AND MANAGEMENT

The broccoli and cauliflower trials were conducted at the Valley Laboratory, Windsor on Merrimac sandy loam, a sandy terrace soil with somewhat limited moisture holding capacity; and at Lockwood Farm, Mt. Carmel on Cheshire fine sandy loam, a loamy upland soil with a moderate moisture holding capacity.

The seed for the spring crop was planted in a greenhouse with vents opened at 70 F and heated when the temperature fell below 50 F. The seedlings were moved to a cold frame for hardening 2 weeks before they were transplanted in the field. Seed for the fall crop was planted outdoors and seedlings were transplanted when

they were 4" high. For the fall crop, second and third plantings were made of Dandy Early, Emperor, Packman, Valiant, and XPH 5004. Seeds were started at 3-week intervals and seedlings transplanted at 2-week intervals following the seeding and transplanting of the first crop. At Mt. Carmel, the fall crop was planted in the same field as the spring crop.

The seedlings were grown in Promix BX in standard plastic pots measuring 2-5/8 by 2-1/4 by 2-5/16" and held in packs of 36. Water soluble 20-20-20 fertilizer was added to the seedlings about 3 to 4 weeks after germination. The seedlings were transplanted in rows 36" apart with spacing 18" within rows to provide 9680 plants/A. Each planting consisted of five randomized blocks with six plants per cultivar in each replication. Transplanted seedlings that died the first week were replaced. In the spring, leaves of all cauliflower cultivars were tied around the newly developing heads, called curds, when they reached about 2" diameter. In the fall, leaves of several cultivars were not tied because they were of the "self-blanching" type in which inner leaves remain tightly furled preventing the curd from turning yellow and also because the sun's intensity had waned.

Mature heads of broccoli and cauliflower were harvested at 3-day intervals. Yields of broccoli were weighed and the quality was judged for color, evenness and compactness of head, excessive stalkiness, and leaves protruding from the head. The quality of cauliflower was judged for size, color, smoothness of curd, and protection of the curd by surrounding leaves of self-blanching types.

TABLE 1--SOIL AND CROP MANAGEMENT OF BROCCOLI (B) AND CAULIFLOWER (C) AND PERTINENT DATES

Activity			Spring crop	Fall Crop
Soil fertilization (Rates based on soil tests)				
10-10-10 (Windsor)		B,C	1300 lbs/A	1300 lbs/A
10-10-10 (Mt. Carmel)		B,C	1300 lbs/A	700 lbs/A
lime (Windsor)		B,C	None	None
lime (Mt. Carmel)		B,C	2175 lbs/A	None
Planting Dates				
Seeding in greenhouse	1st Crop	B,C	March 10	June 19
or outdoor enclosure	2nd Crop	B	-	July 6
	3rd Crop	B	-	July 29
Transfer to cold frame		B,C	April 4-7	-
Transplant seedlings				
to field	1st Crop	B,C	April 21-28	July 22-26
	2nd Crop	B	-	Aug 7-8
	3rd Crop	B	-	Aug 19
Pest Control				
Root maggots		B,C	Lorsban 4E	Lorsban 4E
Cabbage worms		B,C	Malathion 50EC	Malathion 50EC
Irrigation				
Windsor		B,C	4	1
Mt. Carmel		B,C	4	2
Weed Control				
Cultivations		B,C	2	2

The details of management of the soil and crops and pertinent dates are listed in Table 1.

CHARACTERISTICS OF QUALITY

The characteristics of broccoli and cauliflower used to judge marketablility in Tables 2, 3, 4, and 6 require definition.

BROCCOLI

Size of head. Head diameters follow national quality standards for broccoli. They are very large (vlg) 7" or more; large (lg) 5 to 6-7/8"; medium (med) 3-1/2 to 4-7/8"; small (sm) less than 3-1/2". Where two size classes are listed, they are co-dominant. Other classes may constitute less than 20% of the heads.

Leafy. Leaves usually grow on the stalk below the head but extend around and above the head. A leafy head has small to medium sized leaves protruding through the head.

Lumpy. A lumpy head is one in which portions of the head grow faster than others. The uneven surface is less asthetic. Depressions in these heads may collect water and become focal points for bacterial and fungal infections.

Button. Buttoning (but.) is the formation of the head while the plant is small. This is caused by vernalization or chilling of the seedlings. The head is only about 1" wide. Buttoning has been observed mostly on early cultivars. In the spring, Early Emerald, PSR 3481 and PSR 35184 buttoned over 50% at Mt. Carmel but only 20 to 40% at Windsor.

Color. Dark green to bluish green heads are preferred. A purplish cast, generally caused by cold, does not affect marketability. Pale green, yellowish and reddish colors indicate mineral deficiencies, disease, or overmaturity. Brown, black, or water soaked patches indicate disease.

Brown beading. This defect appears as yellow and brown flecks on a maturing head, and is the decay of individual florets within the head. The cause of this symptom is unknown, but it most often appeared in the fall crop.

Corky stem. The external part of the stem cracks and produces light brownish scars. This symptom is thought to be caused by boron deficiency.

Exerted heads. The head is on a stalk that rises above the main body of leaves. Cultivars with well-exerted heads have been developed for mechanical harvest.

CAULIFLOWER

Size of curd. Curd diameters follow national quality standards for cauliflower. They are large (lg) 7" or more; medium (med) 5 to 6-7/8"; small (sm) 3-1/2 to 4-7/8"; and very small (vsm) less than 3-1/2". Where two classes are listed, both are codominant. Other size classes may constitute less than 20% of the heads.

Rough curd. Individual branches within the curd may develop more rapidly than others and create an uneven surface. Rough curds are less appealing to the eye.

Ricey curd. Premature formation and elongation of flower parts which emerge from the curd to create a soft velvety appearance.

Color. Curd color should be white or creamy white. Curds become yellow if exposed to sunlight. Reddish and brownish colors or water soaked appearance generally indicate mineral deficiencies or disease.

Leafy. Leaves that generally wrap around the developing curd protrude from the curd.

YIELD AND QUALITY OF BROCCOLI

Spring crop. The average yields of all cultivars was 7,324 lb/A at Windsor compared to 6,378 lb/A at Mt. Carmel, a difference of 15%. At Windsor, Pirate yielded over 7 tons/A. Emperor, Excalibur, Green Duke, Green Valiant, Mercedes, Packman, Premium Crop, Prominence and XPH 5004 exceeded the national average of 4 tons/A. At Mt. Carmel, Pirate again yielded over 7.5 tons/A. The yields of Emperor, Green Duke, Green Valiant, Premium Crop, Prominence, and PSR 20784 exceeded the national average. It is interesting to note that most of the heavy producers are classified as mid season and late varieties. These varieties had higher yields at Mt. Carmel compared to Windsor despite the lower average yields of all cultivars reported at Mt. Carmel. The lower average yield at Mt. Carmel is attributed to low yields of the early varieties that formed heads on small plants in response to cooler temperatures.

Cultivars with high yields do not necessarily produce heads of good quality. Some high

TABLE 2--YIELD AND QUALITY OF BROCCOLI AT MT. CARMEL AND WINDSOR, SPRING 1986

	Mt. Carmel				Windsor				
	Heads Hvst. %	Avg. Head lb	First Cut lb/A	Side Cuts lb/A	Heads Hvst. %	Avg. Head lb	First Cut lb/A	Side Cuts lb/A	Size and quality of heads
Baccus**	97	0.4	4176	3376	97	0.6	5732	6163	med to lg, compact, leafy
Dandy Early	97	0.4	3713	3106	90	0.8	7332	4639	sm to med, compact
Early Emerald	20	0.4	3497	3642	77	0.5	4529	4800	med, early but., late, compact
Emperor	97	1.4	13093	1432	97	1.1	10471	6097	vlg, lumpy
Excalibur	100	0.6	5347	1447	97	1.0	9565	779	med to lg, leafy
Galaxy+	93	0.5	5126	4103	87	0.7	6501	7273	med to lg, uniform
Green Duke	100	1.4	13568	948	100	1.1	10680	4455	lg, loose, late yellowing
Green Dwarf	90	0.6	5567	3304	90	0.6	5403	5421	med, ball-type, late yellowing
Green Comet+	100	0.5	5187	1016	100	0.7	6825	2510	med, compact, uniform
Green Valiant	97	1.5	14741	1163	100	1.2	11724	3406	vlg, loose, lumpy
Mercedes	93	0.4	4031	1495	100	0.8	7964	1999	sm to med, leafy, lumpy, variable
Orion	80	0.5	4776	3483	63	0.6	6292	5769	med, very leafy
Packman+	63	0.5	4888	5765	93	1.0	9247	6682	med to vlg, early but., compact
Paragon	97	0.5	4672	1973	93	0.5	4522	4557	med, compact, well-exerted
Pirate	100	1.6	15049	1180	100	1.5	14312	3060	vlg, lumpy
Premium Crop+	97	1.1	10430	1010	97	0.9	9129	2612	lg to vlg, compact, uniform
Prominence	90	1.2	11582	2000	100	1.2	11113	6735	vlg, lumpy, well-exerted
Southern Comet+	90	0.4	4076	3582	90	0.5	5015	7163	sm to med, compact, uniform
PSR 3481	50	0.2	2161	6694	60	0.5	4892	9170	extensive early but.
PSR 20684	97	0.3	2747	6156	87	0.5	4883	7188	med, compact, leafy
PSR 20784	100	0.9	8772	2394	100	0.8	7474	5338	med to lg, lumpy, leafy
PSR 21284	73	0.3	2483	5097	83	0.3	2986	7501	med, leafy compact
PSR 21584	97	0.4	3867	2812	100	0.5	4746	6691	med to lg, compact, lumpy
PSR 35184	40	0.2	1631	5807	97	0.4	3534	6408	med, compact, early but.
PSX 21784	97	0.4	5553	4906	100	0.7	6990	6048	med to lg, lumpy, ball-type
XPH 5004+	100	0.5	5099	2532	100	0.9	8577	5170	med to lg, well-exerted

+ Cultivars produced high quality heads at both Mt. Carmel and Windsor.
** Formerly XPH 5003.

yielding cultivars have pronounced defects that affect marketability. The quality and defects are listed in Tables 2 and 3.

Table 2 contains the most prominent characteristics of each cultivar. Among the cultivars that had high yields, only Packman, Premium Crop, and XPH 5004 had high quality. The quality of Galaxy, Green Comet, and Southern Comet was also high but their yields were less than 4 tons/A. Dandy Early, Green Dwarf, Mercedes, Orion, and Paragon, rated highly for yield and quality in 1985 (Hill 1986), fell short of expectations. Southern Comet and XPH 5004 also rated highly in 1985. The remaining cultivars did not produce consistently high quality heads at either site.

Secondary heads form on branches developing from the main stalk after the primary head has been harvested. Their harvest is called "side cutting". Side cutting of the secondary heads

TABLE 3--YIELD AND QUALITY OF BROCCOLI AT MT. CARMEL AND WINDSOR, FALL 1986

	Mt. Carmel			Windsor			
	Heads Hvst. %	Ave. Head lb	First Cut lb/A	Heads Hvst. %	Ave. Head lb	First Cut lb/A	Size and quality of heads
Baccus**	100	0.4	3616	90	0.7	6587	sm to lg, compact, variable
Dandy Early+	93	0.6	6284	100	1.2	11347	med to lg, compact, uniform
Early Emerald	97	0.6	5655	97	1.1	10712	lg, compact, well-exerted, excess. stalkiness
Emperor+	93	0.6	5697	100	0.9	9142	lg, compact, uniform
Excalibur	97	0.5	4750	90	1.0	9554	lg, leafy
Galaxy+	100	0.6	5556	97	1.0	9903	lg, compact, uniform
Green Duke	100	0.7	6473	100	1.5	14273	lg to vlg, brown beading
Green Dwarf	93	0.5	4927	97	0.9	8615	lg, ball-type, brown beading
Green Comet	100	0.5	4550	100	0.7	6534	med to lg, compact, corky stem
Green Valiant+	97	0.6	5669	100	0.8	7693	med to lg, compact, uniform
Mercedes	100	0.8	8085	100	2.3	22147	lg to vlg, loose, lumpy, compact, variable
Orion	93	0.6	5445	100	0.8	7911	med, leafy, lumpy
Packman+	100	0.6	6156	93	1.0	10162	med to lg, compact, uniform
Paragon+	100	0.6	5498	90	0.9	8574	lg, well-exerted, compact, uniform
Pirate	90	0.7	6352	97	1.1	10290	med to lg, lumpy
Premium Crop	93	0.6	6070	100	1.2	11651	lg to vlg, compact, brown beading
Prominence	100	0.8	7931	100	1.8	16958	vlg to lg, well-exerted, lumpy, corky stem
Southern Comet+	100	0.6	6188	100	1.0	9283	med to lg, compact, uniform
PSR 3481	100	0.6	6242	100	0.8	7959	lg, lumpy
PSR 20684	100	0.7	6812	80	1.1	10560	med to vlg, compact, exerted, variable
PSR 20784	100	0.6	5679	100	0.9	8920	med to lg, compact, lumpy, brown beading
PSR 21284+	100	0.5	4642	100	0.8	7419	med to lg, compact, uniform
PSR 21584+	97	0.7	6374	97	0.8	8104	med to lg, compact, uniform
PSR 35184+	100	0.6	6235	97	0.9	8277	med to lg, compact, well-exerted
PSX 21784	93	0.7	6393	93	0.9	8311	med to lg, compact, brown beading
XPH 5004+	93	0.5	5180	97	1.0	9501	med to lg, compact, uniform

+ Cultivars produced high quality heads at both Mt. Carmel and Windsor.
** Formerly XPH 5003.

continued for 4 weeks following harvest of the primary head. Only heads broader than 3" diameter were harvested. Most of their stalks were sufficiently long to bunch for sale. PSR 3481 produced the most side cuts at both sites. Although this variety buttoned severely, the plants produced many side cuts, some with 5" diameter heads after the buttoned heads were removed. Packman and Southern Comet also produced excellent side cuts.

Fall crop. The average yield of all cultivars at Mt. Carmel was 5,864 lb/A compared to 10,016 lb/A at Windsor, a difference of 71%. Compared to spring yields, the fall yields were 36% higher at Windsor but 8% lower at Mt. Carmel. The unusually low yields at Mt. Carmel in the fall were probably caused by damaging winds and rain soon after planting. Parts of the field were eroded and many plants were uprooted or their upper root systems were

TABLE 4--YIELD AND QUALITY OF BROCCOLI IN THREE SUCCESSIVE FALL PLANTINGS AT MT. CARMEL AND WINDSOR

	Mt. Carmel			Windsor			
	Heads Hvst. %	Ave. Head lb	First Cut lb/A	Heads Hvst. %	Ave. Head lb	First Cut lb/A	Size and quality of heads
First Crop							
Dandy Early+	93	0.6	6284	100	1.2	11347	med to lg, compact, uniform
Emperor+	93	0.6	5697	100	0.9	9142	lg, compact, uniform
Green Valiant+	97	0.6	5669	100	0.8	7693	med to lg, compact, uniform
Packman+	100	0.6	6156	93	1.0	10162	med to lg, compact, uniform
XPH 5004+	93	0.5	5180	97	1.0	9501	med to lg, compact, uniform
Second Crop							
Dandy Early	67	0.6	6062	87	0.7	6489	sm to med, compact, leafy, variable
Emperor+	90	0.7	6703	97	0.7	6594	med to lg, compact, uniform
Green Valiant+	93	0.9	8305	100	0.9	8426	lg, compact, uniform
Packman+	97	0.8	7411	100	0.7	6355	med to lg, compact, uniform
XPH 5004+	97	0.6	6154	100	0.7	6379	med to lg, compact, uniform
Third Crop							
Dandy Early	67	0.3	2966	90	0.2	2145	sm, leafy
Emperor	83	0.4	4318	97	0.4	4110	sm to med, compact, variable
Green Valiant+	77	0.8	8147	90	0.4	3874	med to lg, compact, uniform
Packman	80	0.5	4721	100	0.4	4058	med, compact, leafy
XPH 5004	90	0.3	3220	100	0.2	2395	sm to med, compact, leafy

+ Cultivars produced high quality heads at both Mt. Carmel and Windsor.

exposed. Although uprooted plants were replaced and exposed roots buried, plants were stunted during the early stages of their growth. The same storm did not damage the crop at Windsor.

At Windsor, all but four cultivars yielded above the national average. Here, Mercedes, Prominence, and Green Duke yielded from 11, 8, and 7 tons/A respectively. Although these cultivars produced very large 10-12" heads, their quality was poor. The heads of Mercedes exceeded 2 lb, but rampant growth produced loosely branched, lumpy, unattractive heads. Heads of Green Duke were large and compact but brown beading spoiled their appearance. Prominence had very large to large well-exerted heads, but their stems were tough with corky exteriors and discolored interiors.

At Mt. Carmel only Mercedes and Prominence exceeded the national average of 4 tons/A. Despite low average yields, the quality and yields of several cultivars were excellent. Packman and Galaxy had the best quality coupled with high yields. Dandy Early and XPH 5004 also had high quality and were consistent with results in 1985 (Hill 1986). The yields and quality of Emperor, Green Valiant, Paragon, Southern Comet and PSR 21284, PSR 21584, and PSR 35184 were consistently excellent.

The yields of side cuts were not measured for the fall crop. However, Galaxy, Packman, Baccus, and XPH 5004 produced many.

Serial plantings fall crop. The varieties selected for serial planting were those suggested for the 1986 Broccoli Project. The yield and quality of the second and third crops of Dandy Early, Emperor, Green Valiant, Packman, and XPH 5004 are reported in Table 4. All

TABLE 5--MATURITY OF BROCCOLI AT MT. CARMEL AND WINDSOR, SPRING AND FALL 1986

	Mt. Carmel				Windsor			
	Harvest Midpoint		Harvest Span		Harvest Midpoint		Harvest Span	
Cultivar	Spring Days*	Fall Days*	Spring Days**	Fall Days**	Spring Days*	Fall Days*	Spring Days**	Fall Days**
Baccus***	46	56	15	3	50	48	17	6
Dandy Early	46	63	15	3	53	58	12	14
Early Emerald	42	60	11	14	46	51	14	11
Emperor	58	67	6	11	56	62	13	11
Excalibur	47	67	16	11	51	62	17	15
Galaxy	46	63	24	10	50	58	14	14
Green Duke	57	63	23	11	53	62	27	14
Green Dwarf	50	71	23	6	53	65	16	11
Green Comet	51	66	27	15	53	58	14	14
Green Valiant	60	71	4	6	60	69	14	8
Mercedes	48	67	30	8	53	65	16	14
Orion	42	71	35	7	50	69	26	8
Packman	48	63	27	15	50	55	11	14
Paragon	48	66	24	11	46	55	17	7
Pirate	57	77	24	7	53	72	10	21
Premium Crop	62	67	20	4	56	62	27	1
Prominence	60	66	16	7	53	62	13	7
Southern Comet	48	70	23	11	46	62	17	7
PSR 3481	39	74	15	4	42	69	5	8
PSR 20684	35	67	18	10	44	65	14	7
PSR 20784	59	71	23	21	53	69	21	14
PSR 21284	35	67	15	14	42	62	14	3
PSR 21584	39	71	24	7	44	62	17	3
PSR 35184	50	74	35	7	42	65	11	8
PSX 21784	35	74	18	17	53	65	31	11
XPH 5004	50	63	7	11	53	55	7	10
Average	48	68	20	10	50	62	16	9

*Time from transplanting to midpoint of harvest.
**Time from start to finish of harvest of primary heads.
***Formerly XPH 5003.

varieties grown in the first crop at both sites had shown consistently good quality with medium to large densely compacted heads. In the second crop, Green Valiant had the greatest yield at Mt. Carmel and Windsor and its quality remained high. At Mt. Carmel, yields of Emperor, Packman, and XPH 5004 exceeded the first crop. At Windsor, the second crop of Green Valiant increased to over 4 tons/A, but all other cultivars had lower yields. The quality

of all cultivars remained high except Dandy Early, which produced leafy heads.

In the third crop, yields of most cultivars at both sites were dramatically less. At Mt. Carmel, however, the yields of Green Valiant remained above 4 tons/A, and high quality was maintained. At Windsor, yields of Green Valiant were lower, but quality was excellent. All other cultivars produced small to medium heads that were leafy or of inconsistent size.

Maturity. Knowing the time to produce a mature plant from seed or transplant allows the grower to schedule planting for harvest at a specific time. In Table 5, the days to maturity were calculated from the day of transplanting to the day when half the heads were harvested; i.e. the harvest date of the 15th head from a population of 30 plants.

For the spring crop, time to maturity among the 26 cultivars varied from 35 to 62 days at Mt. Carmel and 42 to 60 days at Windsor. The very early maturity of PSR 3481, PSR 20684, PSR 21584, and PSR 21784 at Mt. Carmel caused smaller heads and lower yields than their longer maturity at Windsor. For all cultivars, the average time to maturity at each site differed by only 2 days.

For the fall crop, time to maturity at Mt. Carmel ranged from 56 to 74 days and at Windsor, 48 to 72 days. The average time to maturity for all cultivars was 68 days at Mt. Carmel and 62 days at Windsor. Maturity at Mt. Carmel was undoubtedly delayed by the recovery period following the storm that eroded the field and disturbed roots.

Another important facet of maturity is the span of harvest, which I define as the days between the harvest of the first and last marketable head. Short harvest spans favor a single harvest by hand or machine. In the spring, only XPH 5004 had a short harvest span at both sites. Emperor and Green Valiant had short harvest spans only at Mt. Carmel. In the fall, many cultivars matured during a short span. The average of all cultivars was about 10 days at both sites. As the days to maturity increased in the fall compared to the spring, the harvest span decreased. Obviously, conditions that speed maturity in the spring do not affect all plants of the same cultivar equally. This is especially noticeable in early maturing cultivars that tend to button during cold springs. Some individuals become vernalized in the seedling stage, others do not.

YIELD AND QUALITY OF CAULIFLOWER

Spring crop. The average yield in spring of all cauliflower cultivars at Windsor was 13,589 lb/A compared to 11,587 lb/A at Mt. Carmel, a difference of 17%. Andes and Polar Express yielded most at both sites with 8.5 to 11.0 tons/A (Table 6). In fact, seven of 10 cultivars at both sites yielded above the national average of 5.4 tons/A (Anon. 1985).

Among the seven cultivars that had high yields, five had consistently good quality. Andes and Polar Express produced large smooth curds, weighing nearly 2 lb. Curds of Snow Crown, White Empress, and White Knight were more variable in size, but their quality was consistently good.

Fall crop. The average yield of all cultivars was 15,224 lb/A at Windsor compared to 12,631 lb/A at Mt. Carmel, a difference of 20%. The yields of Andes, Polar Express, Snow Crown, White Knight and PSX 27885 were 8 to 9.5 tons/A at Windsor and 6 to 7.5 tons/A at Mt. Carmel. Virtually all cultivars exceeded the national average of 5.4 tons/A. Snow Crown and PSX 27885, however, suffered some browning of curds that made them less desirable. Andes, Polar Express, White Knight and PSR 100184 had consistently good quality as well as high yields. A notable characteristic of PSR 100184 was its resistance to hollow stem. The remaining cultivars grown in the fall had inconsistent quality or suffered defects of browning or ricey curd. Most cultivars grown in the spring and fall had hollow stem, which is associated with boron deficiency.

Maturity. Maturity of cauliflower is important to schedule planting for a specific harvest period. The days to maturity were calculated from the day of transplanting to the day when half the curds were harvested (Table 7). Among the 10 cultivars planted in spring, time to maturity was consistent at both sites and ranged from 40 to 68 days at Mt. Carmel and 38 to 66 days at Windsor.

In the fall, time to maturity of these same 10 cultivars was longer. The array of

TABLE 6--YIELD AND QUALITY OF CAULIFLOWER AT MT. CARMEL AND WINDSOR, SPRING AND FALL, 1986

	Mt. Carmel			Windsor			
	Curds Hvst. %	Ave. Curd lb	Total Yield lb/A	Curds Hvst. %	Ave. Curd lb	Total Yield lb/A	Size and quality of curd
Spring Crop							
Alert	90	0.7	6859	93	1.0	9486	sm to med, smooth
Andes*+	97	1.9	18385	100	2.3	21925	lg smooth, uniform
Dominant	90	1.2	11547	90	1.6	15536	sm to med, extensive browning
Early Abundance	83	0.6	5656	70	0.6	6096	sm to med, smooth, uniform
Polar Express+	100	1.8	17438	100	1.8	17844	lg, smooth, uniform
Snowball	97	1.5	14577	100	1.7	16573	sm to med, leafy
Snowball T3	80	0.5	5137	87	0.8	7249	sm to med, browning
Snow Crown+	100	1.2	11218	97	1.3	12865	med to lg, uniform
White Empress*+	97	1.2	11292	100	1.4	13329	med to lg, uniform
White Knight*+	97	1.4	13761	97	1.6	14988	med to lg, smooth, uniform
Fall Crop							
Alert	83	1.2	11674	90	1.8	17137	med to lg, smooth, browning
Andes*+	80	1.2	12107	97	1.7	16310	med to lg, smooth, uniform
Dominant	80	1.1	10460	90	1.3	12404	sm to med, rough, extensive browning
Early Abundance	90	1.2	11128	73	1.6	15340	med, rough, variable
Polar Express+	83	1.4	13318	83	1.6	15943	med, smooth, uniform
Snowball	77	1.3	12240	73	1.5	14814	med, smooth, browning
Snowball T3	90	1.3	12392	90	1.2	11950	med, smooth, browning
Snowball Improved*	80	1.4	13155	87	1.4	13356	med, slightly hairy
Snow Crown	87	1.4	13795	100	1.9	18718	med to lg, rough to smooth, browning
Snow King*	83	1.6	15877	100	1.6	15978	med to lg, smooth, hollow stem rot
Snow Pak*	90	1.3	12959	90	1.5	14608	med to sm, rough to smooth, variable
White Empress*	93	1.1	10481	93	1.6	15173	med, hairy, browning
White Knight*+	83	1.4	13607	93	1.7	16827	med to lg, smooth, uniform
PSR 100184*+	87	1.5	14551	97	1.4	13899	med, smooth, resists hollow stem
PSR 27785Y*	83	1.0	9155	87	1.2	11934	med, smooth, hairy, variable
PSX 27885*	77	1.5	15200	100	2.0	19188	med, rough, stem hollow, browning

*Self blanching.
+Cultivars produced high quality heads at both Mt. Carmel and Windsor.

maturities also became broader because of additional cultivars in the fall crop. The range in harvest midpoint at Mt. Carmel was 56 to 111 days and for Windsor, 49 to 103 days. In the fall, cauliflower took an average of 17 days longer to mature at Windsor and 24 days longer at Mt. Carmel than in the spring. The extra week at Mt. Carmel was undoubtedly caused by the storm that delayed maturity of broccoli. The shorter time to maturity in spring was undoubtedly caused by longer days and higher temperatures as the crop matured compared to shorter days and lower temperatures in the fall.

In the spring, the average harvest span of all cultivars was 23 days at Mt. Carmel and 18 days at Windsor. In the fall, the harvest span decreased to 16 days at Mt. Carmel and 13 days at Windsor. As with broccoli, the harvest

TABLE 7--MATURITY OF CAULIFLOWER AT MT. CARMEL AND WINDSOR, SPRING AND FALL 1986

	Mt. Carmel				Windsor			
	Harvest Midpoint		Harvest Span		Harvest Midpoint		Harvest Span	
Cultivar	Spring Days*	Fall Days*	Spring Days**	Fall Days**	Spring Days*	Fall Days*	Spring Days**	Fall Days**
Alert	48	72	28	5	52	72	18	7
Andes	68	88	22	31	66	73	10	17
Dominant	64	111	25	23	59	103	22	18
Early Abundance	44	72	27	9	38	72	14	6
Polar Express	60	77	14	12	59	74	13	10
Snowball	60	92	30	27	56	94	17	39
Snowball T3	40	72	20	17	52	72	30	18
Snowball Improved	-	106	-	20	-	90	-	29
Snow Crown	54	72	16	14	56	68	24	8
Snow King	-	60	-	11	-	54	-	7
Snow Pak	-	106	-	15	-	98	-	21
White Empress	67	77	26	12	56	72	17	6
White Knight	57	77	24	9	56	72	17	3
PSR 100184	-	97	-	20	-	94	-	18
PSR 27785Y	-	56	-	14	-	49	-	28
PSX 27885	-	67	-	9	-	64	-	15
Average	56	81	23	16	55	72	18	13

* Time from transplanting to midpoint of harvest.
** Time from start to finish of harvest.

span decreases as time to maturity increases.

PLANTING STRATEGIES

The 1986 trials demonstrate that broccoli and cauliflower of commercial quality can be produced in Connecticut during June. A fall crop of broccoli of commercial quality can be harvested from early September through mid-November and cauliflower from mid-September through mid-November except in the normally colder areas of Litchfield and Windham Counties where killing frosts occur late in October. The fall harvest is terminated by a killing frost with temperatures in the low 20s. Night temperatures between 25 to 32 F have little detrimental effect on quality. Although maturity may be slowed, the taste of broccoli may improve after mild frosts.

Broccoli. The spring harvest was shorter than the fall harvest because of the onset of hot weather in July. Harvest in June was produced from a single transplanting from April 21 to 28. Several cultivars with varying maturity provided a protracted harvest in June with a single planting. The dates for harvest of preferred cultivars at Mt. Carmel (MCMC) and Windsor (WWW) are shown in Figure 1.

Selection of three cultivars with different maturities including Galaxy as the early and Premium Crop as the late would provide well-balanced harvests during June. The data also suggest that a second planting in the

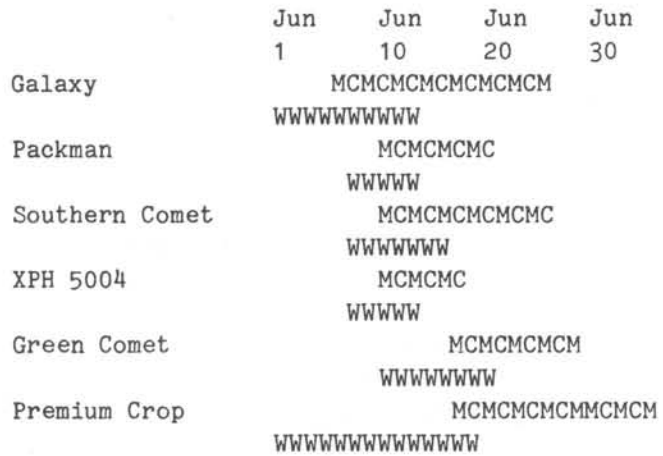

Fig. 1—The harvest dates for high quality broccoli in the spring at Mt. Carmel (MCMC) and Windsor (WWW)

Connecticut Valley of Galaxy, Packman, and XPH 5004 to fill out harvests in the last half of June. The second crop would be planted no later than May 1.

Packman planted in mid-April has a tendency to button in upland areas of central Connecticut where spring temperatures are cooler. Delaying planting until May 1 would reduce buttoning. In the normally cooler areas of Litchfield and Windham Counties, spring plantings after May 1 would reduce losses from buttoning, especially in early maturing cultivars.

The fall crop has a longer harvest period and permits more options for selection of cultivars and number of plantings. I tested three successive plantings of Dandy Early, Emperor, Green Valiant, Packman, and XPH 5004 that were suggested for the 1986 Broccoli Project. The harvest dates for the cultivars that produced consistently high quality heads in each crop are shown in Figure 2.

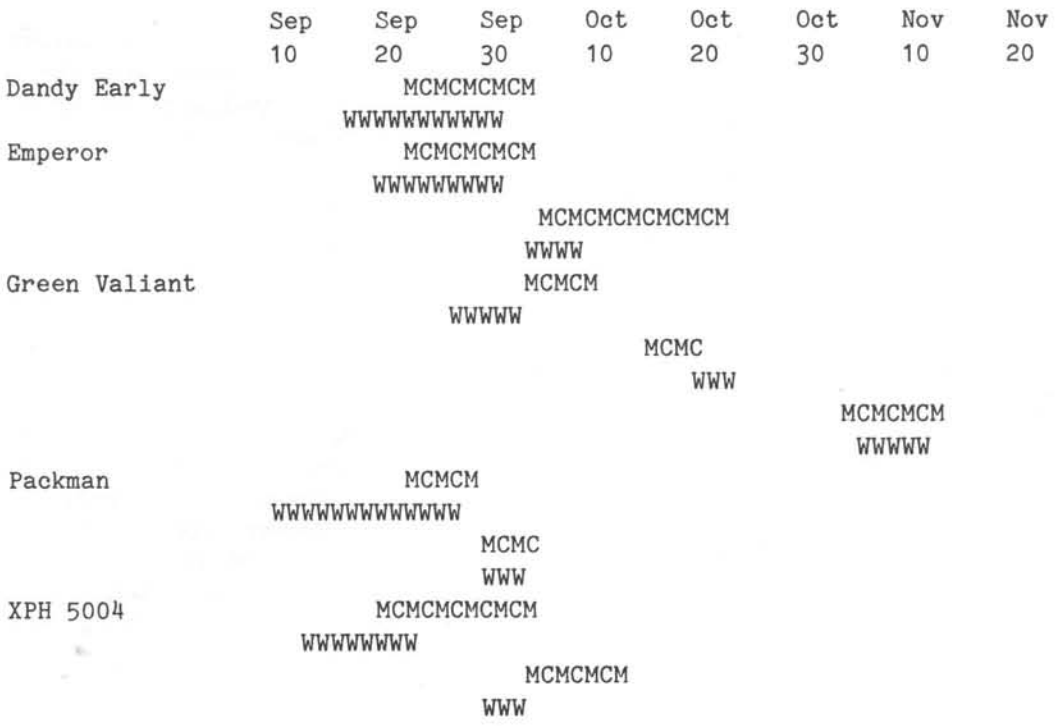

Fig. 2—The harvest dates in fall for high quality broccoli in three crops at Mt. Carmel (MCMC) and Windsor (WWW)

Harvest of the first planting at Mt. Carmel (July 22 to 26) began September 19 with Packman (early) and concluded October 10 with Green Valiant (late). These two cultivars did not provide continuous harvest. The gap from September 26 to October 4 could have been filled with any of the other preferred cultivars. Thus, using three cultivars of differing maturities would provide continuous harvest from September 19 through October 10.

At Windsor, harvest of the first planting (July 22 to 26) began with Packman on September 11 and concluded with Green Valiant on October 3. Here, these two cultivars provided continuous production.

Harvest of the second planting (August 7 to 8) began on September 29 to 30 with Packman and concluded October 23 with Green Valiant. Thus, the second crop of Packman began before the first crop of Green Valiant concluded and partially filled the gap between September 26 and October 4 in the first crop of Packman and Green Valiant. Thus, a third cultivar in the first crop could be effectively replaced by a second crop of an early cultivar, i.e. Packman.

The second crop of Packman and Green Valiant did not provide continuous harvest from September 30 to October 23. Harvest gaps occurred from October 7 to 17 at Mt. Carmel and October 3 to 20 at Windsor. Emperor and XPH 5004 filled the gap at Mt. Carmel and Emperor at Windsor. Dandy Early, planted in early August, fell from the list of preferred cultivars because of its small leafy heads.

In the third crop, Green Valiant alone remained on the preferred list. Its planting August 19 provided a late harvest from November 5 to 14. Although the yield at Windsor was somewhat low, its quality was superb. The other preferred cultivars produced leafy heads of inconsistent size in the third crop. Third plantings seem impractical for the colder areas of Litchfield and Windham Counties because of earlier damaging frosts.

A gap remained from October 23 to November 5. With an overlap in harvest between the first and second crop, but not between the second and third, planting of the second crop of Valiant might be delayed to about August 10 to 15. How Emperor, Packman and XPH 5004 would react is unknown since their quality declined between the second planting (August 5) and the third (August 19).

In summary, satisfactory yields of broccoli can be attained in spring and fall with two or three cultivars with different maturities. In the fall, two or three plantings, each utilizing two or three cultivars, provide the longest harvest.

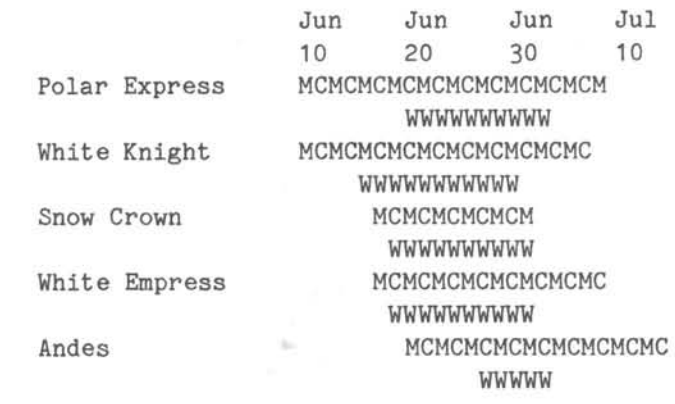

Fig. 3—Harvest dates for high quality cauliflower in the spring at Mt. Carmel (MCMC) and Windsor (WWW)

Cauliflower. The spring harvest of cauliflower, like broccoli, was shorter than the fall (Table 7). Production in June was accomplished with transplants set between April 21 to 28. Planting cultivars with varying maturity provided harvest from mid-June to mid-July. The inclusive dates for the harvest of preferred cultivars are shown in Figure 3.

At Mt. Carmel, a combination of Polar Express and Andes provided the broadest harvest span, from June 11 to July 16. At Windsor, these two cultivars again provided the broadest harvest span, from June 13 to July 3.

The harvest span was shorter at Windsor than at Mt. Carmel. It is unknown if a second planting at Windsor about May 1 could have extended the harvest to mid-July. Other cultivars began to show defects in early July.

The earliest harvest in the spring trial was from Early Abundance. Harvest began on June 6 at Mt. Carmel and June 2 at Windsor. The curds were small to medium but free of defects. Although yield per acre was relatively small, this cultivar could provide early maturing curds for the fresh market. Delay in planting of

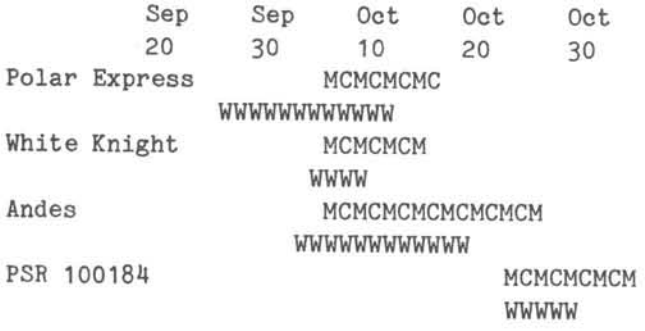

Fig. 4—Harvest dates for high quality cauliflower in the fall at Mt. Carmel (MCMC) and Windsor (WWW)

Early Abundance to May 1 would probably produce larger heads, but its advantage of earliness would be lost.

Delay in planting of cauliflower until May 1 in the cooler areas of Litchfield and Windham Counties would reduce buttoning.

Fall cauliflower has about the same harvest span as in spring, but the time to maturity is longer. The inclusive dates for the harvest for preferred cultivars are shown in Figure 4.

A combination of Polar Express or White Knight and Andes or PSR 100184 provided the longest harvest at Mt. Carmel. At Windsor, Polar Express and PSR 100184 provided the longest harvest. Few gaps would appear in harvest if combinations of these cultivars were used. Although serial planting of these cultivars to expand the harvest remains untested, a second planting of White Knight and Polar Express about August 5 to 10 may provide harvest in late October or early November in the Connecticut Valley where killing frosts occur later than in Litchfield and Windham Counties.

In summary, satisfactory yields of cauliflower can be attained in spring and fall utilizing two or three cultivars with different maturities to attain the broadest harvest period.

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