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Globe Artichokes in Connecticut

BY DAVID E. HILL

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The production of globe artichokes for American markets is largely confined to coastal California where cool summers and mild winters favor year-round supply from about 9,500 acres. Although nearly 60% of California's artichokes are sold locally in the Los Angeles-San Francisco region, 30% of the crop is shipped to the New York-Boston region (Anon. 1985).

As an alternate crop for Connecticut farmers, artichoke culture captured my attention 4 years ago because the state lies in the center of an important artichoke-consuming region and an artichoke crop has a high cash value.

The globe artichoke, a biennial plant, grows vegetatively the first year and matures the second, sending forth the edible flower buds. When artichokes are grown from seed, this two-year cycle requires mild winters for survival; but Connecticut's winters are severe and only heroic measures of plant protection have allowed artichokes to survive. The growth cycle of the plant, however, can be shortened by vernalization of seed (moist chilling) and application of gibberellic acid (GA3) to young plants (Gerakis, Markarian and Honma 1969). These treatments initiate flower budding in 5 to 6-month-old plants and permit production of artichokes in a single year. Thus, the globe artichoke may be grown as an annual plant.

In this Bulletin, I report experiments with management requirements, yield and quality trials, and winter protection in Connecticut.

MATERIALS AND METHODS

Vernalization of seeds and seedlings. Vernalization, or moist chilling of seeds, was begun between January 25 and February 5 for harvest of artichokes beginning in late July. Seeds were soaked in water for 2 days at room temperature; packed in moist, unshredded sphagnum moss in an unsealed plastic bag; and refrigerated 4 weeks at 35 to 40 F. The seeds were examined periodically and moistened when necessary to prevent drying. After 2 to 4 weeks, the germinated seeds were ready to be planted if the root emerged 1/2 to 1 inch.

Greenhouse management. About March 5 to 10, germinated seedlings were transferred to 1-quart plastic containers filled with Promix BX and placed in a greenhouse. The peaty potting mixture contained enough fertilizer to maintain early growth. Because warm days may devernalize the seedlings (Harwood and Markarian 1968), the greenhouse was heated or ventilated to maintain temperatures between 50 F at night and 65 F during the day. No supplementary light was used to extend daylength. About 20% more seeds must be germinated to allow culling of stunted plants. About April 10 to 25, seedlings were transferred to a cold frame to harden before transplanting in the field.

Transplanting. Trials were conducted at the Valley Laboratory, Windsor, on Merrimac fine sandy loam, a sandy terrace soil with somewhat low moisture holding capacity; at Lockwood Farm, Mt. Carmel, on Cheshire fine sandy loam, a loamy upland soil with moderate moisture holding capacity; and at Comstock-Ferre Farm, Wethersfield, on Hadley silt loam, a silty flood plain soil with high moisture holding capacity. The soils were fertilized with 1300 lb/A of 10-10-10 and limed to attain a pH of 6.5. Plants were set in the field May 5 to 10. The

container-grown plants had prominent tap roots curled at the bottom of each pot. After the root ball was removed from the pot, the tap root was straightened, and the plant was set in a hole deep enough to accommodate its length. Plants were set 3 feet apart in rows 4 feet apart, a density of 3,630 plants/A.

Plot design and the cultivars used varied according to the objective of the experiment. In 1984, Green Globe and Grande Buerre were planted at Mt. Carmel in 4 rows of 15 plants each. Treatments were vernalization and GA3, GA3 without vernalization, vernalization without GA3, and no vernalization and no GA3. In 1985, 50 plants each of Green Globe, Grande Buerre, Green Globe Improved, and Purple Globe were planted at Windsor and Mt. Carmel. To determine the most effective time of GA3 treatment, 10 vernalized plants of each cultivar were treated on June 30, July 10, July 20, and July 30. Ten vernalized plants remained untreated. In 1986, this experiment was repeated at Windsor and Mt. Carmel, except that Purple Globe was not grown at Windsor. In addition, 20 vernalized plants of each cultivar were planted at Wethersfield. Fifteen of twenty plants were selected for treatment with GA3 on July 17; five were untreated. Plants with visible flower buds on the treatment date were not treated.

One hundred parts per million GA3 was applied to foliage on each treatment date. By June 30, all plants had reached the 10-leaf stage required for treatment (Gerakis, Markarian and Honma 1969).

Pest control was not needed. Minor infestations of aphids in the greenhouse were controlled by indigenous lady beetles after transplanting in the field.

Weeds were controlled by grass mulch in 1984 and by cultivation in 1985 and 1986.

Artichokes were harvested and weighed before the lowest bracts on the bud began to unfurl. Artichokes smaller than 70 grams (2.5 oz) were culled.

The yields reported for each cultivar are averages for the four treatment dates. Since some treatment dates did not produce optimum response of the plants to GA3, I report the yields as "potentials", taking into account only those plants that set buds and eliminating those that were barren because of poor timing of treatment. Actual yields can be calculated by multiplying the buds/acre x % plants producing in Table 3.

Winter protection. A dry mulching technique used to protect roses in winter (Rose, Pellett, and Aleong 1982), was applied to barren artichoke plants in the fall. In mid-December 1984, the tops of barren plants were severed 1 inch above ground after they had partially withered from earlier frosts. Plastic bags were filled with vermiculite, perlite, or styrofoam chips, inserted into 2-gal black plastic pots, and inverted over the plant stump. The inverted pots were pinned with stakes to resist wind. Leaves were piled around the inverted pot, with drain holes open for ventilation. For comparison, other plants were simply mulched with 8 inches of leaves. Ten plants received each treatment. In addition, six plants of Green Globe and Grande Buerre were dug November 1, placed in 2-gal pots, transferred to a cool greenhouse (50 to 65 F) over winter, and on May 1, 1985, replanted in the field.

RESULTS

Vernalization and GA3 treatment. In initial experiments in 1984, I determined the response of Green Globe and Grande Buerre artichoke plants to vernalization and GA3 treatment, (Table 1). Flowering of both cultivars was greatest with vernalization of seed and seedlings and treatment with GA3. GA3 treatment alone was clearly more effective than vernalization alone. In 1985, however, up to 100% of vernalized Green Globe, Green Globe Improved and Grande Buerre plants not treated with GA3 flowered (Table 2). I speculate that the poorer

TABLE 1--PERCENT OF ARTICHOKE PLANTS FLOWERING IN RESPONSE TO VERNALIZATION AND GA3 TREATMENT IN 1984

	+Vern +GA3 %	+Vern -GA3 %	-Vern +GA3 %	-Vern -GA3 %
Green Globe	80	10	35	0
Grande Buerre	40	5	25	0

response of plants to vernalization alone in 1984 was probably due to devernalization by high temperatures during hardening in a poorly ventilated cold frame. In 1986, delayed vernalization in late February caused some cultivars to produce buds late in October when damaging frosts occurred.

The percentage of plants producing buds was not consistently affected by GA3 treatment among years (Table 2). In 1985, treatment with GA3 increased buds of Green Globe, Green Globe Improved, and Purple Globe by 15 to 83% at Mt. Carmel, and -9 to 300% at Windsor. At Mt. Carmel, all plants of Grande Buerre

TABLE 2--RESPONSE OF VERNALIZED PLANTS TO GA3 TREATMENT ON DIFFERENT DATES IN 1985-1986 (10 PLANTS/TREATMENT)

	Mt. Carmel				Windsor			
	% Plants Budding		Buds/Plant*		% Plants Budding		Buds/Plant*	
	1985	1986	1985	1986	1985	1986	1985	1986
Green Globe								
June 30	90	70	2.2	1.2	90	100	1.8	2.2
July 10	100	70	2.5	2.6	70	90	1.5	1.9
July 20	100	60	2.7	1.1	70	100	2.3	2.6
July 30	100	80	2.6	1.3	100	50	2.9	1.1
Average (treated)	98	70	2.5	1.5	82	85	2.1	2.0
Untreated	70	70	2.4	0.9	90	100	2.4	2.2
Grande Buerre								
June 30	100	90	2.5	1.8	80	90	1.1	1.6
July 10	100	40	2.9	0.6	60	100	1.0	1.9
July 20	100	70	2.4	1.5	70	90	1.2	2.0
July 30	100	80	2.9	1.2	90	90	3.1	2.3
Average (treated)	100	70	2.7	1.3	75	92	1.6	2.0
Untreated	100	60	2.7	1.5	70	60	2.1	0.9
Green Globe Impr.								
June 30	90	30	1.7	0.5	90	40	1.6	0.6
July 10	90	40	1.9	1.3	90	30	2.3	0.9
July 20	100	0	2.3	0	70	0	1.8	0
July 30	90	10	2.4	0.1	70	0	1.6	0
Average (treated)	92	20	2.1	0.5	80	18	2.2	0.4
Untreated	80	0	1.8	0	60	0	1.4	0
Purple Globe								
June 30	50	20	0.8	0.2	20	-	0.3	-
July 10	70	0	1.8	0	40	-	0.6	-
July 20	50	20	1.0	0.4	40	-	0.8	-
July 30	50	0	1.1	0	20	-	0.4	-
Average (treated)	55	10	1.2	0.2	30	-	0.5	-
Untreated	30	10	0.7	0.2	10	-	0.2	-

*Barren plants were excluded from calculations.

produced artichokes, and at Windsor, treated plants with buds increased 7% compared to untreated.

In 1986 at Mt. Carmel, most cultivars had 28-72% fewer plants respond to GA3 treatment compared to treated plants in 1985. There was a similar response among untreated vernalized plants. In 1986 at Windsor, however, Green Globe and Grande Buerre had 3-17% more plants respond to GA3 treatment compared to 1985. In 1986, untreated Green Globe Improved was barren at both sites. At Mt. Carmel and Windsor, GA3 treatments on June 30 or July 10 caused 30-40% of Green Globe Improved to form buds. At Mt. Carmel, Purple Globe responded poorly to GA3 treatment.

Although GA3 treatment accelerates bud development and earliness (Snyder, Welch, and Rubatzley, 1971), it is important to determine its effect on yield. There was no clear effect of GA3 treatment on yield of Green Globe and Grande Buerre for 1985 and 1986 (Table 2). I averaged the buds/plant for the four treatment dates and compared them to buds produced by untreated plants for each cultivar. It is evident that GA3 treatment does not consistently increase the number of buds/plant for Green Globe and Grande Buerre. These cultivars are easily vernalized and can form productive laterals without GA3 treatment.

By comparison, Green Globe Improved and Purple Globe responded to GA3 treatments. Seeds and seedlings of these cultivars are more difficult to vernalize and GA3 treatment in 1985 and 1986 at both sites increased production by 0.3 to 0.8 buds/plant. Despite the increased production caused by GA3 treatment, however, neither Green Globe Improved nor Purple Globe matched the yield of Green Globe or Grande Buerre.

TABLE 3--YIELD OF ARTICHOKES FROM VERNALIZED PLANTS TREATED WITH GA3

	Windsor			Mt. Carmel			Wethersfield		
	Plants Producing %	Buds/ Plant No*	Buds/ Acre No**	Plants Producing %	Buds/ Plant No*	Buds/ Acre No**	Plants Producing %	Buds/ Plant No*	Buds/ Acre No**
1984									
Green Globe	-	-	-	73	4.4	15972	-	-	-
Grande Buerre	-	-	-	40	1.7	6171	-	-	-
1985									
Green Globe	84	2.6	9438	92	2.7	9801	-	-	-
Grande Buerre	74	2.5	9075	100	2.7	9801	-	-	-
Green Globe Imp.	76	2.3	8348	90	2.3	8348	-	-	-
Purple Globe	26	1.8	6534	50	2.2	7986	-	-	-
1986									
Green Globe	88	2.3	8348	70	2.1	7623	40	3.9	14157
Grande Buerre	86	2.0	7260	68	1.9	6897	60	3.8	13794
Green Globe Imp.	14	2.1	-	14	3.0	-	10	3.5	-
Purple Globe	-	-	-	12	1.6	-	0	0	-

*Barren plants were excluded from calculations.
**Potential yields are calculated from average buds/plant x 3630 plants/A. California yields are about 11,000 buds/A.

Neither percentage of plants producing artichokes nor buds/plant offer a clear indication of the best date of GA3 treatment. In 1985 at Mt. Carmel, percentage of plants with buds was greatest with July 10 treatment, but at Windsor, with June 30 or July 30 treatment. In 1986, the highest percentage of plants with buds occurred with June 30 treatment at both sites. In 1985, the greatest number of buds/plant followed July 30 treatment, but in 1986, followed July 10 treatment.

Yield. In frost-free California, larger plants are grown at wider spacing than in Connecticut. With 1,100 plants/A (Ryder, DeVos, and Bari 1983) and an average of 10 buds/plant, about 11,000 buds/A in each crop in California.

In 1984 at Mt. Carmel, Green Globe averaged 4.4 buds/flowering plant, the highest yield among all cultivars (Table 3). With 3,630 plants/A, Green Globe could produce nearly 16,000 buds/A. Grande Buerre yielded only 40% as many.

In 1985, the average potential yield of four cultivars at Mt. Carmel was 8,984 buds/A and at Windsor, 8,349 buds/A, a difference of 8%. At both sites, Green Globe and Grande Buerre had the highest potential yields, which would approximate California's production. "Potential" yield is the yield calculated for (buds/flowering plant) x (number of all plants). Mt. Carmel had the highest percentage of budding plants.

In 1986, the average potential yield of Green Globe and Grande Buerre at Windsor was 7,804 buds/A, at Mt. Carmel, 7,260 buds/A, and at Wethersfield nearly twice as many, 13,976 buds/A. Although fewer plants produced artichokes at Wethersfield, higher yields were borne on larger plants. Green Globe Improved and Purple Globe were excluded from the averages because of the low percentage of budding plants.

At Mt. Carmel and Windsor, the percentage of budding plants and yield/plant were less in 1986 compared to 1985. Among sites, Windsor had the highest percentage of budding plants and Wethersfield the lowest.

Maturity. Table 4 lists the harvest dates of all cultivars at all sites for 1984-1986. The first date represents the harvest of the first artichoke of commercial quality. Early production of small artichokes was not included. The concluding date was usually when the temperature fell below 25 F.

In 1984, the harvest began in late August and concluded in early October, a 6-7 week harvest. A killing frost ended the harvest.

In 1985, harvest of most cultivars began July 16 to 17 at Mt. Carmel and Windsor and concluded with killing frosts on October 24 at Windsor and November 11 at Mt. Carmel.

TABLE 4--HARVEST DATES OF ARTICHOKES IN 1984-1986

	Mt. Carmel	Windsor	Wethersfield
1984			
Green Globe	Aug 22-Oct 9	-	-
Grande Buerre	Aug 27-Oct 9	-	-
1985			
Green Globe	Jul 17-Nov 11	Jul 16-Oct 24	-
Grande Buerre	Jul 17-Nov 11	Jul 16-Oct 24	-
Green Globe Impr.	Jul 17-Nov 11	Jul 16-Oct 10	-
Purple Globe	Jul 30-Nov 11	Jul 30-Oct 24	-
1986			
Green Globe	Jul 21-Oct 10	Jul 10-Sep 25	Jul 17-Oct 16
Grande Buerre	Jul 17-Oct 10	Jul 10-Sep 25	Aug 12-Oct 16
Green Globe Impr.	Jul 27-Oct 16	Aug 12-Oct 9	Aug 26-Oct 16
Purple Globe	Jul 27-Sep 12	-	-

Harvest lasted 17 weeks at Mt. Carmel and 14 weeks at Windsor for most cultivars.

In 1986, harvest at Mt. Carmel began July 17 and concluded October 16, a 13-week period. At Windsor, harvest of three cultivars began on July 10 and concluded on October 9, a 13-week period. At Wethersfield, harvest of Green Globe lasted 13 weeks, but harvest of Grande Buerre and Green Globe Improved started late and concluded after 7-9 weeks. Despite the early conclusion of harvest of the four cultivars on October 9 to 16, the harvest of other cultivars not included in this study began in late August and concluded November 5 with a killing frost at all sites.

Finally, the harvest period of 1985 was extended by formation of a second crop on some plants. Plants that had produced artichokes by mid-August withered and sent forth new shoots from the root crown. Artichokes were produced on about 5% of these resprouted plants.

Winter protection. Artichoke plants that are unproductive the first year despite vernalization or GA3 treatments require winter protection. Three methods can be considered: 1) outdoor mulching, 2) repotting the whole plant for indoor maintenance, and 3) root storage.

Periodic examination of the soil surrounding the root crown of mulched plants revealed that the soil remained unfrozen except when temperatures fell below 15 F. At this time frost penetration was about one inch.

Vermiculite pillows offered the best protection for both Green Globe and Grande Buerre. Perlite and styrofoam were less effective protectors for both varieties. Plants that were merely covered with leaves did not survive. In the spring, surviving plants had viable shoot buds on the root crown just below ground level. If buds were numerous, the roots were dug and cut into two or three "stump pieces" and replanted. If the buds were few, the root was replanted intact. Only a third of the plants from stump pieces had buds, and they averaged 1.4 buds/plant. About 55% of the roots planted intact yielded 2.1 buds/plant.

Plants dug and placed in 2-gal plastic pots in a cool greenhouse survived well. The plants did not enlarge and maintained a relatively constant number of leaves. As old leaves died at the base, new leaves emerged from the crown. After replanting in the field on May 1, the plants grew. Harvest began July 30. Nearly 85% of Green Globe had buds and averaged 3.2 buds/plant. Only 33% of Grande Buerre had buds and produced an average of 3.0 buds/plant.

Attempts to store dug artichoke roots over winter were largely unsuccessful. Only 5% of roots stored at 40 F survived.

TABLE 5--PERCENT SURVIVAL OF ARTICHOKE PLANTS PROTECTED BY DRY MULCHES OR LEAVES IN THE FIELD

	Green Globe %	Grande Buerre %
Vermiculite	60	40
Perlite	30	10
Styrofoam	0	20
Leaves	0	0

CONCLUSIONS

1. Artichokes of commercial quality can be grown in Connecticut. Three years of testing have shown that the harvest period ranges from 6-17 weeks and is highly dependent upon local climate. Artichokes seem best suited for Connecticut's roadside and farmers markets for retail sales because the harvest generally occurs in the summer and early fall when wholesale prices are low. November harvests are preferable because the California crop is insufficient to meet consumer demand and prices rise. November harvest, however, requires careful control of the growth cycle of the plant and cooperative weather.

2. Gibberellic acid to promote early budding is necessary only if the crop shows no bud formation. Only barren plants need to be treated between July 10-20.

3. Winter protection is expensive, labor intensive, and likely has no place in commercial production. For the home gardener with a few plants, winter protection by moving barren plants to a cool, sunny area indoors may suffice. Artichokes normally appear on replanted plants as they complete their biennial cycle.

4. Among the four cultivars tested, only Green Globe and Grande Buerre approached

California yields. About 30 cultivars from Mediterranean countries will be tested in 1987.

REFERENCES

1. Anon. 1985. Agricultural Statistics 1985. USDA. 551p.

2. Gerakis, P.A., D. Markarian, and S. Honma. 1969. Vernalization of globe artichoke, Cynara scolymus L. J. Amer. Soc. Hort. Sci. 94:254-8.

3. Harwood, R.R. and D. Markarian. 1968. Annual culture of globe artichoke (Cynara scolymus L.). I. Preliminary Report. Proc. Amer. Soc. Hort. Sci. 92:400-9.

4. Rose, A.E., N.E. Pellett, and J. Aleong. 1982. Effect of protective covers on cold acclimation and survival of Hybrid Tea roses. J. Amer. Soc. Hort. Sci. 107:1173-7.

5. Ryder, E.J., N.E. DeVos, and M.A. Bori. 1983. The globe artichoke (Cynara scolymus L.). HortSci. 18:646-53.

6. Snyder, M.J., N.C. Welch, and V.E. Rubatsky. 1971. Influence of gibberellin on time of bud development in globe artichoke. HortSci. 6:484-5.

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