FINAL REPORT -- FARMER GROWER GRANT FNE 96-131

Northeast Region Sustainable Agriculture Research and Education Program

Project Title: High Density Planting for Weed, Disease and Pest Management in Commercial Strawberry Production

Project Leader: Upinngil/Clifford Hatch

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Project Goals:

1. Demonstrate and test alternative strawberry planting systems to provide effective weed and pest management for organic and conventional growers.

2. Provide a cost comparison between conventional practices and the projects' alternative practices.

3. Communicate with other strawberry growers the practices being trialed and their practical application.

Project Leader's Farming Operations:

Upinngil is a diversified farming operation, primarily involved in organic strawberry production with sidelines in organic truck crops, small grains, forage crops, beekeeping, and purebred sheep. The farm consists of 24 acres owned in the Town of Gill and another 50 acres leased from family in the Town of Granby. Most of the acreage is under certified organic management except for 5 acres which is used for hybrid vegetable seed production.

Project Cooperators:

CISA,c/o University of Massachusetts, Tillson House, Amherst, MA 01002. The CISA Project's Sustainable Practices Action Group coordinated and supported farmer field days at farms of the project.

Everett Hatch, Hatch's Patch, 170 Plain Road, Greenfield, MA 01301. Cooperating farm responsible for planting the "control" planting according to traditional standards and practices as well as demonstrating two alternative planting systems with greatly reduced herbicides. Host farmer field demonstration days.

New England Vegetable & Berry Growers Association. Sponsors of the NEVBGA Conference and Trade Show, Sturbridge, MA which provided a forum for final presentation of complete project outreach presentation, December 17, 1997.

NOFA-Mass, Edwin McGlew, 40 Chestnut Street, Hatfield, MA 01038. Technical advisor for organic standards and practices. Coordinator of Conference for presentation of project outreach to other growers, January 1997.

University of Massachusetts Cooperative Extension, Sonia Schloemann, Agroecology Program, Fernald Hall, Amherst, MA 01003. Technical advisor to project and coordinator of farmer field days.

Project Methods:

The project involved two farms, Upinngil and Hatch's Patch. Each farm planted a demonstration planting trialing alternative methods for strawberry production.

The Upinngil planting was a one acre planting of strawberries using a high density system(6" spacing within the row and 36" between rows)of four cultivars to achieve a "narrow spaced row". This system was planted at three intervals and managed under certified organic production.

The goal of the Upinngil planting was to determine whether a significant difference could be ascertained between plantings set in mid-June to mid-July. The cultivars Earliglow, Kent, Seneca and Lateglow were used. Plantings of each cultivar were made on June 21, July 5, and July 17.

Equipment modified from an earlier SARE project (FNE 95-87) was to conduct the planting on a 1 acre plot that had been cover-cropped especially for strawberries. The field was tilled, fertilized and fitted with raised beds on 36" centers. Flame weeding was used to establish a stale seed bed, mechanical cultivation and hand-hoeing and weeding were used to control weeds throughout the growing season. Runners were set and pruned by hand as well as mechanically. Between row cultivation was conducted at 10 day intervals maintaining maximum bed width of 14". The plantings were irrigated during the vegetative and fruiting seasons and mulched before winter. During the vegetative season the planting received pesticide sprays for strawberry root worm beetles (Pyrellin EC, rotenone) and fungicide sprays for leaf spot (Kocide LF).

During the fruiting season mulch was raked into the alleys. Pest traps were set in early May prior to bloom. The season was abnormally cold and bloom was delayed 2-3 weeks. Pesticide sprays (Pyrellin EC) were applied for tarnish plant bug and fungicide spray for leaf spot (Kocide LF). Measurement of the number of inflorescence per meter was made of each cultivar during its peak bloom as the best indicator of plant development/maturity.

Renovation began less than 1 week after harvest completion. Beds were narrowed with rolling cultivators, which also cast dessicated mulch onto remaining plants. Leaves were not removed

from the plants (no mowing). Fertilizers was applied (30lbs. N ac.), and irrigation was applied after a two week rest. A single hand weeding and scouting was conducted in late August. Mechanical cultivation was conducted continuously between the rows at 10 day intervals.

The Hatch's Patch planting was a 1.33 acre plot of mixed planting densities/intervals/herbicides to achieve traditional "matted rows". The goal of this planting was to compare the traditional practices for establishing the matted row system with two alternatives, in order to reduce herbicide use and time/labor/management costs. The cultivars Annapolis, Honeoye and Mohawk were used.

The entire 1.33 acre had been cover-cropped in preceding years. The field was tilled, fertilized and fitted to beds on 48" centers. Half the field was treated with Dachtal into which the cultivars Annapolis and a trial of Mohawk were planted in the first week of May (bare-root plants 24" spacing). The remainder of the field was left for stale seed bed preparation. Prior to planting, the latter half of the field was treated with Gramaxone Extra to create a stale seed bed.Bare root plants of Annapolis and Honoeye varieties were set at 6" spacing between plants in the first week of July. Six rows were reserved to retrial a system which had failed in a previous SARE Farmer/Grower project (FNE 95-87). In these beds (stale seed beds/gramaxone) Annapolis plants that had been potted into 4" plastic pots in early May were transplanted at the beginning of July when they had produced their first runners.

Throughout the vegetative season irrigation was supplied as needed and weeds were controlled between the beds with mechanical cultivation. Runners were set conincident with hand hoeing in July and August. The entire plot was mulched for overwintering. There were no pesticide applications made for disease or insects in the vegetative season. The grower's customary application of Devrinol to control weeds was made prior to mulching.

In the fruiting season mulch was raked into the alleys and pest traps were set in May before blossoming. The number of inflorescence per meter was measured for each cultivar/planting design when the cultivars were at peak bloom. Prior to bloom and during early bloom applications of Thiadan for tarnish plant ~~but~~ and Captan and Ronolin for botrytis were made.

Rennovation entailed mowing of leaves, a herbicide application of Sinbar,narrowing of rows, and fertilizing (30lbs. N ac.). Irrigation was provided after a 2 week rest to initiate regrowth, and later season mechanical cultivation controlled weeds between the beds.

5. Findings/Accomplishments/Unexpected Results:

Upinngil Findings:

1. Stale seed bed (propane flame weeding) and the rapid establishment of crop canopy with the high density planting system reduces the weed pressure from summer annual weeds (amaranth, lamb's quarters, purslane) significantly reducing the greatest expense of organic management--hand hoeing and weeding. There is no benefit however to the control of persistent winter annuals such as shepherd's purse and purslane speedwell or perennials like chickweed, mouse eared chickweed, and chamomile.

2. Earlier plantings of the high density system generally will be heavier yielding i.e. have greater number of inflorescence/fruiting bracts than later plantings. However the June planted sections required much pruning. There was runner production greatly in excess of the desired row width in all varieties except Earliglow in the June planted sections.

3. The variety Earliglow showed the least acceptability for delayed planting. Comparison of 1996 and 1997 data show steep decline of inflorescence with delay in planting. Although a decline in inflorescence is expected with later planting dates Earliglow showed the greatest decline of the varieties tested in 1997.

4. Varieties with later blossoming habit show greater acceptability to delayed planting. The varieties Seneca and Lateglow showed the least decline in inflorescence through later planting.

5. Kent was the most productive variety in the trial (greatest inflorescence). It and Lateglow required the most pruning of excess runners respective to the date of establishment. Kent responded ~~most~~ as expected by scoring most inflorescences per meter: June 21--34, July 5--29, July 17--25.

Hatch's Patch Findings:

1. There was no significant difference between the planting with the pre-emergent herbicide and the stale seed bed. Both methods controlled summer annual weeds equally well. Neither brought control of persistent winter annual and perennial weeds (shepherd's purse, chickweed, mouse-eared chickweed, chamomile).

2. There was no increase in disease or pest pressure between the conventionally planted section and the "high density" section or the "potted section".

3. The "potted plants" system scored highest on the number of inflorescence per meter however the difference between it and the conventionally planted area is not significant. The succeess of this system in this trial versus the 1995 trial failures is

largley attributable to the use of 4" plastic pots in the nursery versus 3" peat pots and transplanting to the field in early July versus mid-July.

4. The Annapolis cultivar, like its parent Earliglow, is not well adapted to delayed planting systems. There was high mortality in the Annapolis high density plantings which was not apparent in the Honoye planting. Although the inflorescence count was not significantly different between the Honoye and Annapolis, rows of Annapolis in the high density section had to be repaired by consolidation of rows during the vegetative season. No such consolidation or repair was necessary in the Honoye.

5. The high density/delayed planting of Annnapolis and Honoye scored lower than the potted plants or the conventionally planted Annapolis. However the score of the high density plantings were significantly higher than the conventionally planted Mohawk variety. The difference between the conventionally planted Mohawks and Annapolis is attributed entirely to cultivar there was no other difference in their treatments.

Comparison Upinngil/Hatch's Patch findings:

1. Persistent weed pests in strawberry plantings that are difficult or impossible to eradicate and that require hand labor in either system are: shepherd's purse, chickweed, mouse-eared chickweed, purslane speedwell, and oxalis.

2. The tarnished plant bug problem on both farms was due to the lateness of the bloom period that year. The number of adults on traps at the beginning of bloom required immediate action. A "normal" season usually requires action in later blossoming.

3. The high density/delayed planting design established a narrow spaced row with suitable number of mature fruiting plants and with a close row spacing (36") satisfactory acre/yields are achieved. However its suitablility for establishing a wide matted row is questionable since there was a great difference between the number of inflorescence in the conventional/control planting and the high density planting. Although the matted rows were equally full of plants between systems, many of the plants in the high density system for matted rows lacked the maturity for multiple inflorescence. The grower (Everett Hatch) was satisfied with the final fruit yield (his target for "satisfactory" = meeting or exceeding 5 ton/acre).

4. Not mowing or removing leaves from plants as part of renovation reduces the weed pressure and slows the increase of hard to manage perennial weeds.

Specific Site Information

There is no significant site information that should affect the replication of these trials. Both farms in the trial are on soils classified as "Prime Farmland" and well suited for strawberry crops. The only unusual variable--the weather, which was abnormally cold in the fruiting season, delaying blossoming--was the same for both farms.

Economic Findings

The costs and associated risks of certified organic strawberry production using a delayed high-density planting system are significantly higher than that of conventional commercial management. The planting expense of an acre of conventional strawberries in these trials (exclusive of fixed overhead expenses) was $1393.00 and the high density system under organic management was more than double that at $2884.00.

The alternative systems used in these trials compared more favorably; the potted system planting expense was $1836.00 and the high-density planting expense was $2149. However the risk levels of any delayed planting are greater than those planted earlier in the season. A shortened establishment season gives less time for the repair of any errors or crop failure. Additionally since the plant cost of these systems is high any mistakes are also costly, e.g. a fertilizer attachment malfunction damaged the roots on several rows of transplants which had to be replaced. The extent of the damage was not determined or repaired until those transplants failed to emerge like the rest of the planting. Fourteen days of growing season, the cost of the transplants and the labor to replant by hand were expended. The decrease in labor and management costs by shortening the growing season is significant for an organic grower where labor demands are excessive, however, for a conventional grower to enjoy economic benefit by delayed planting an additional incentive such as harvest of an earlier crop from the land may be needed to offset some of the risk.

The blossom count/yield potential of the high-density system between the two farms was not significantly different. The blossom count between the conventional practice and the high density system varied by 25% on the conventional farm. Using the high-density system to create wide matted rows on wide spacings is questionable. Although the rows readily widen and revert to matted rows in successive years if not pruned, the high density system is suited to narrow row spacings to avoid depressing yields in the first fruiting year.

For detail on specific costs see the attached summary/comparison of planting costs.

Generation of New Ideas/Next Steps

Ultimately the choice of planting system depends on the grower's market. Generally a narrow row system with evenly spaced and matured plants will yield larger fruits which ripen quickly. These systems are well suited to growers whose market is picked fresh berries. Large berries bring a good price and require less picking labor. The drawback to these systems is that the grower must be able to sell quickly or store the fruit as ripening is fast and picking is constant. It is not the best system for u-pick only growers. Wider row systems where individual plants receive less sun and the fruit enjoys more shade will produce less large fruit and more medium sized berries that ripen over a longer season than a narrow row system. This system generally produces larger fruit in its first year and size decreases in later years as the number of plants in a given area increases.

The experimentation that has been done indicates that further work could take place varying plant spacings within the row correlated to the planting date. The question of growers at most outreach activities was "how much they could or could not shorten their season given their latitude or elevation?"

Continued Use of the Investigated Practice

Upinngil has continued the use of the high density system and has augmented it to produce wide beds by planting two staggered high density rows at 24" spacing on 6' bed centers. The high density system works well for producing high quality picked fruit. However, our u-pick customers generally enjoy picking on a wider bed, there is less walking, fruit ripens more evenly.

A high density planting system (transplants spaced at 6-10 inch apart within their respective row), establishes a crop canopy quickly that suppresses weeds without increasing disease and pest pressures, moreover the shading provided to the plants by one another reduces heat stresses on plants. This system of planting compared to the usual practice of 24-30 inch spacings is better suited to organic production and the increased plant costs are offset by decreased labor costs. However the shortening of the establishment season is the part of the system that Upinngil is still experimenting. There are significant variations between cultivars for their suitability to delayed planting/shortened growing seasons.

Communications with Other Growers Concerning the Project

The project generated a great deal of interest with other growers. Since the project's inception the manufacturer of Dachtal, the herbicide of choice for strawberry growers, has decided not to re-register the product for use on strawberries. Dachtal's discontinuance created interest by conventional growers on the use of the stale seed-bed and alternate herbicides employed in the project. Most growers are interested to know how short they may be able to make their establishment season. Caution is emphasized on this point due to my experience that

taking a month or thirty days off the growing season is easy but that halving the customary 120 days to 60 days is risky.

Overall, I am enthusiastic about the work that has been done and encourage other growers to adopt the practices if they will fit into their farm's management. I have been able to condense the management of my strawberry enterprise to a much shorter season that provides more flexible scheduling at a critical point in the growing season, spring planting.

Outreach

The outreach for the project had three principal components. On farm a visual display explaining the project was maintained during the picking season and guided tours and explanation of the practices being demonstrated was given to interested parties. Two farmer field days were held, one in September of 1996 at the collaborating farm and the other in June of 1997 at the project leader's farm. Cooperative Extension and the CISA Project solicited the attendees at these field days which were attended by approximately 20 growers each event. The third component of the outreach program entailed a comprehensive slide presentation with handouts detailing the methods and expenses of the project that was presented at the Mass NOFA Winter 1997 Conference in January, a presentation for the New England Vegetable and Berry Growers Association Conference in December 1997 and a presentation to the Columbia County Cornell Cooperative Extension in March 1998.

Slides

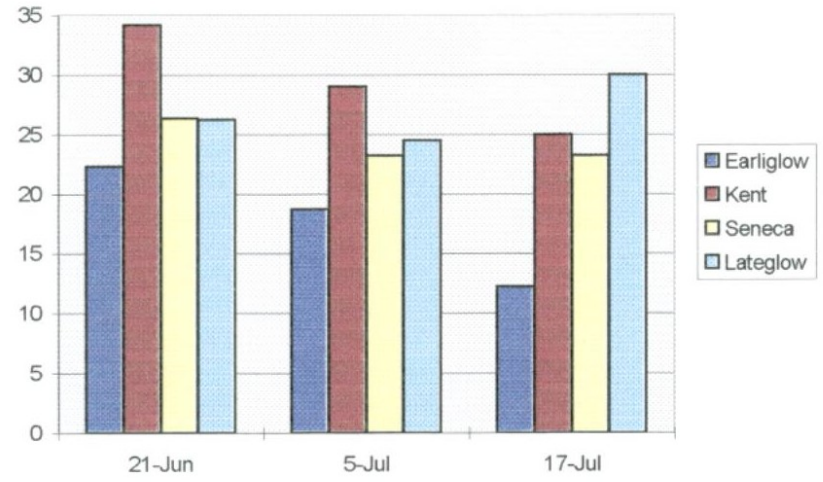
Collaborating Farm

1. Control Group, Annapolis plants set in May at 24"
2. High Density Group, Annapolis and Honoye set in July at 6"
3. Potted Group, Annapolis set in July at 24"
4. The Control and Experimental Groups, how they compared in the fall prior to mulching.

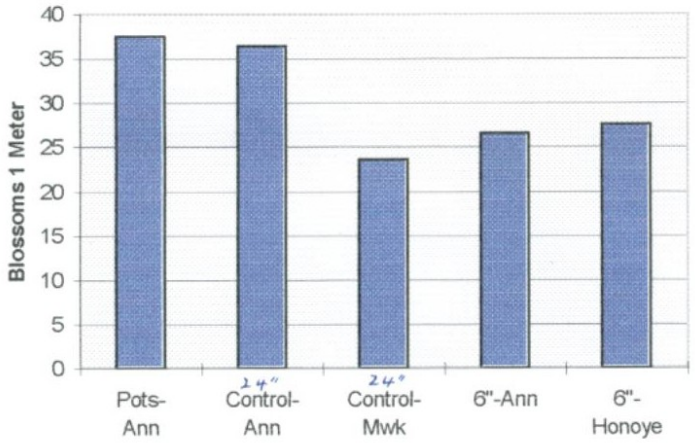
Project Leader's Farm

5. Setting dormant plants, modified planter and leased tractor
6. 1 acre of high density planting, 36" rows, 6" spacings, 28,000 plants/acre.
7. Comparison between June and Mid-July plantings, left June Planted, right mid July planted (note the amount of runners on the June group versus the July group
8. The high density planting in Spring 97

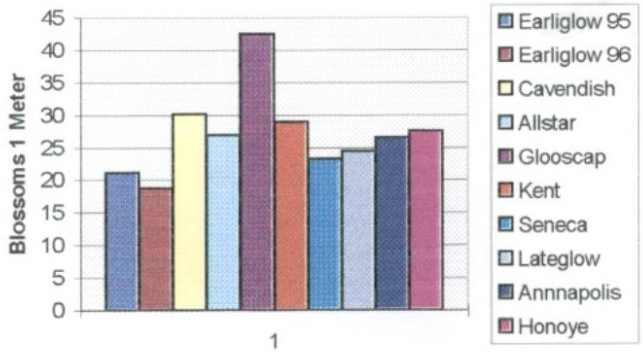
High Density Planting, Three Intervals



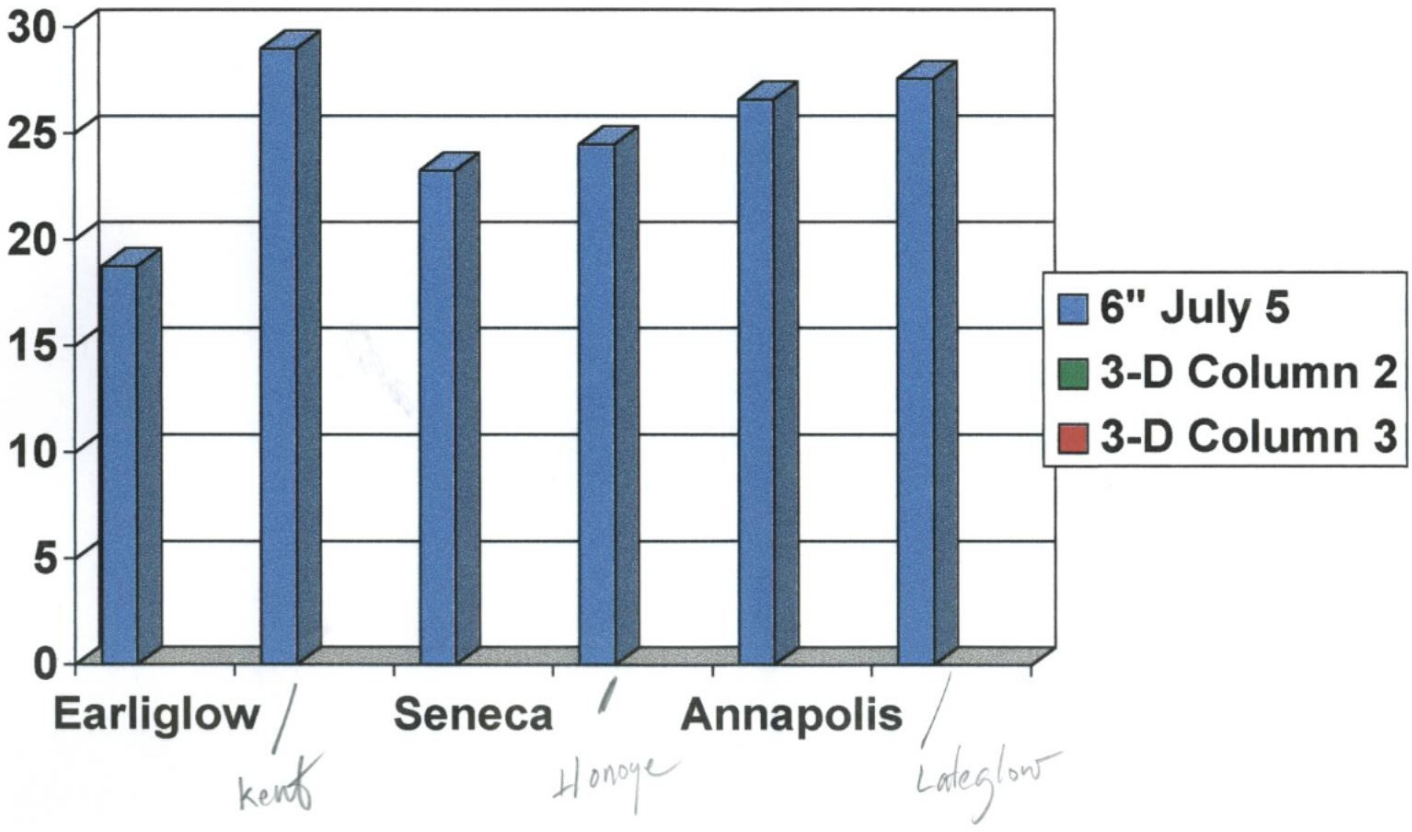
Comparison of Planting Systems



Comparison of Cultivars Planted July 5, 6" Spacing



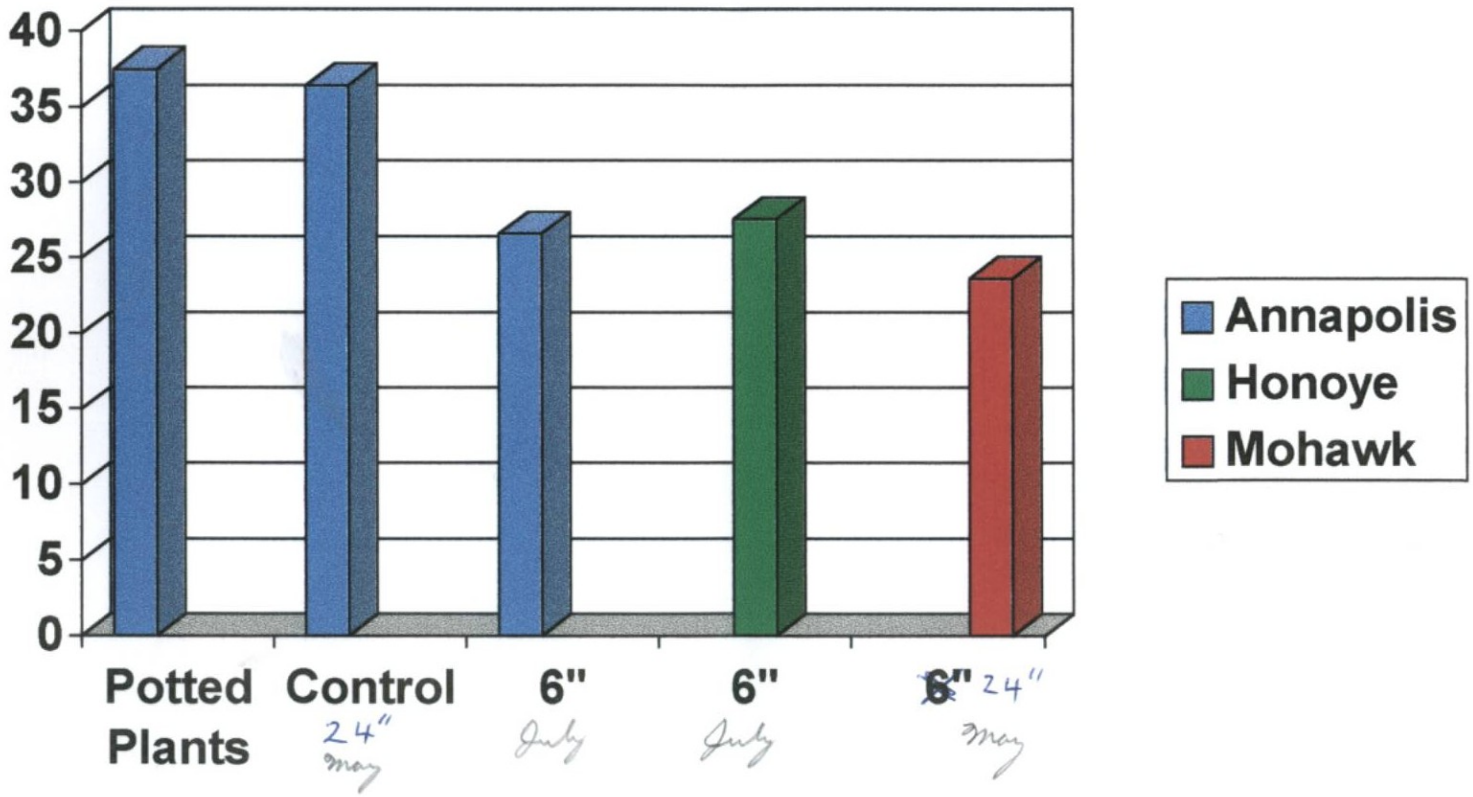
High Density Plantings by Cultivar



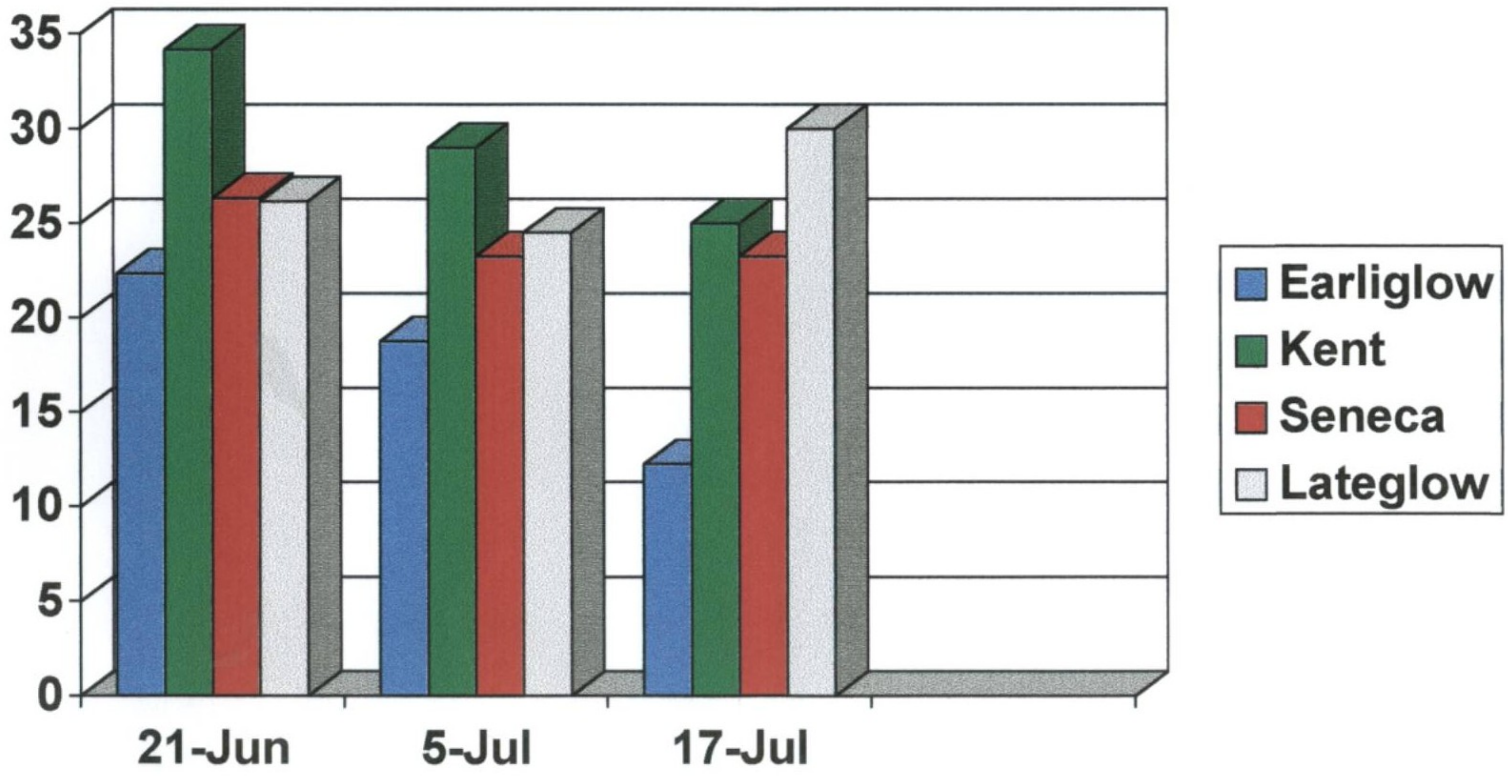
Both Farms

Collaborating Farm

Blossoms Per Meter In Alternative Planting Systems



Blossoms Per Meter at Staggered Planting Intervals



1997 Data collected on plantings from 1996 set at 10-14				
	Lateglow	Earliglow	Seneca	Kent
21-Jun	30	21	25	32
	19	23	24	34
	33	22	31	36
	18	25	29	39
	25	23	27	35
	32	20	22	29
	26.16667	22.33333	26.33333	34.16667
6-Jul	24	17	21	32
	29	16	26	28
	19	23	23	27
	26	19	23	29
	24.5	18.75	23.25	29
17-Jul	40	8	19	30
	24	16	24	29
	24	12	27	17
	32	13	23	24
	30	12.25	23.25	25
1997 Data collected on plantings that varied by planting				
Bare root July planting 6" spacing				Planted 19
Annapolis	Honoye			
19	37			
22	32			
32	24			
29	26			
31	17			
26.6	27			
	23			
	29			
	27			
	36			
	34			
	27			
	29			
	18			
	27.57143			
Annapolis in pots, set in July at 24"				Planted 19
35				
48				
37				
30				
37.5				
Bare root plants set in May 1996 on 24" centers				
Annapolis	Mohawk			
36	14			
28	16			
42	15			

38	27			
52	18			
36	19			
36	52			
46	39			
44	28			
34	17			
34	16			
27	22			
26	24			
25	23.61538			
23				
32				
49				
45				
39				
36.42105				

Planting Costs

Comparison of four planting systems and different management systems; cost is for planting 1,000 row feet. Calculate acre costs by multiplying by 10.8 for 48" row-centers or by 14 for 36" row-centers. No overhead costs are factored into these comparisons. The comparison is between labor and plant costs for each planting system/density.

I. Traditional Matted Rows (planted in mid-May, 120 day establishment)

Plants	500 @ $82/1,000	41.00		
Planting Labor	2 hr. @ 8	16.00		
Dachtal	12 lb./acre	8.00		
Labor	June, July, cultivating	64.00*	total	**$129**

II. Potted Plants (planted early July, 80 day establishment)

Plants	500 @ $82/1000	41.00		
Labor	Potting, 3 hr.; watering etc. 3 hr., planting 4 hr.: 10 hr. @ 8	80.00		
Potting Mix	2 bales	30.00		
4" Pots and Trays	(cost/3)	18.00		
Gramaxone Extra		1.00	total	**$170**

III. High Density for Matted Rows (6" plant spacing, early July, 80 day establishment)

Plants	2,000 @ $82/1,000	164.00		
Planting Labor	4.25 hr.. @ 8	34.00		
Gramaxone Extra		1.00	total	**$199**

IV. High Density for Spaced Rows, Organic Management (6" plant spacing, early July, 75-95 day establishment).

Plants	2,000 @ $82/1,000	164.00		
Planting Labor	4 hr.. @ 8	32.00		
Pre-plant Flaming	1 hr labor, $2 propane	10.00	total	**$206**

*The conventional grower added the cost of cultivating the control group for June and July in order to balance the expense that was saved by the delayed planting in the other systems. Mechanical cultivation for organic and conventional systems is virtually the same. In conventional systems with herbicides hoeing is required by the end of the season and is usually done coincident with setting runners. Under organic management hoeing is required every 10 days during the establishment season . Hoeing 1,000 row feet of berries requires 2hrs labor, six hoeings (for plants established in early July) would add $96 to the establishment costs of every 1,000 row/ft. The additional cost of 2 hoeings or $32 could be added to the cost of the systems utilizing herbicides.