the western day-neutrals suffer from disease susceptibility and stress during summer heat periods. 'Selva' is not a reliable summer and fall fruit producer in the Northeast.

Trends in New Cultivar Production

At the request of the industry, we have given day-neutral breeding a larger emphasis in our improvement program. Emphasis has been placed on medium runnering, high vigor, and consistent but more moderate levels of summer fruiting, with more consistently large fruit size. Selections EB 454, 460 and 461 are the most promising strong day-neutrals; EB 390, 410 and 411 the best intermediate strength day-neutrals. These are grown on raised beds, either as spaced matted rows, or as mulched single hills.

Short-day emphasis aim to combine vigor and broad disease tolerance with fine fruit flavor, improved shelf-life, dual purpose fruit usage and the high color, firmness, size, etc. levels already achieved. Highly promising selections now are: Earlies—MDUS 5129, 5130, 4923 and 4787; Mids—MDUS 4552 and 4589; Lates—MDUS 5084, 5086, 5266 and 4740.

Somaclonal selection at various places has produced some interesting infividuals, but the critical comparison between hybrid seedling and somaclonally induced variability has yet to be made.

Fruit Varieties Journal 43(1)33-37 1989

Southern United States Strawberry Cultivars[1]

JUDITH D. CALDWELL[2]

The past 10 years have brought many changes to strawberry production in the South. Florida and Louisiana maintained their well established shipping industries but not without cultivar changes. The Arkansas shipping industry disappeared, along with an estimated 400 acres, but 'Cardinal' held its place as the states leading cultivar. Tennessee experienced tremendous growth, expanding from 700 to 2400 acres. Many states matured through their "pick-your-own" infancy, developing strong, competitive markets. Other states, long accustomed to the crop, found consumer interest waning and now look toward an uncertain future. A few are just discovering strawberries as an alternative crop and are excited about their potential.

Support for strawberry research also increased over the past 10 years. Cultivar trials in the southern region were expanded or established, production practices were improved and alternative cultural systems developed. Grower education became a priority in many extension systems and growers reached

[1]Technical Contribution No. 2887 of the South Carolina Agricultural Experiment Station.
[2]Associate Professor, Department of Horticulture, Clemson University, Clemson, S.C. 29634-0375.
[3]The author wishes to express her gratitude to the following research and/or extension specialists for their information and insight: Alabama, Arlie A. Powell; Arkansas, James N. Moore; Florida, Earl Albregts, Craig K. Chandler, C. M. Howard; Georgia, M. E. Ferree, Gerard Krewer, Stephen C. Myers; Kentucky, Gerald R. Brown; Louisiana, Tony J. Di Vittorio; Mississippi, Barbara J. Smith; North Carolina, Ron Goldy, Barclay E. Poling; South Carolina, G. Ansel King; Tennessee, Alvin D. Ruthledge; Texas, Calvin G. Lyons, Kim D. Patten; Virginia, Charles O'Dell, Herbert D. Stiles.

out to learn from each other. They have become more sophisticated in their use of fumigation, irrigation, renovation and pesticides or in some cases, included these practices as a routine part of their production schedules.

Innovations from other parts of the country were attempted. Ribbon rows came and went, but narrow beds were generally accepted. Spring planting for same year harvest was abandoned but fall establishment of matted rows for spring harvest became a common practice in many areas. Annual hill culture was introduced to the coastal plains of North Carolina and is gaining acceptance throughout the region. Row covers are receiving considerable attention and trickle irrigation for matted rows, as well as annual systems, is being discussed.

Cultivar selection continued to be a problem in many areas. Anthracnose (*Colletotrichum fragariae*) for example, is a common and devastating disease found throughout the South, yet most of the cultivars grown have no resistance. Annual hill growers attempted to escape establishment problems by purchasing plants from nurseries located as far north as Canada. Still, an intense and costly chemical control program was often required to maintain plantings and/or minimize infection during the flowering and fruiting stage. Control became even more difficult in matted row plantings once temperatures began to rise. High humidity enhanced the development of other leaf and fruit diseases and high summer temperatures were blamed for poor post-renovation recovery and runner production. It seemed that cultivars choosen for their excellent fruiting characteristics were not always capable of thriving in the southern climate.

Annual Hill Cultivars

Florida has been and continues to be the leading strawberry producer in the South (Table 1). The large fresh market shipping industry is located primarily in the central part of the state with a few scattered acreas of "pick-your-own" fruit in southern and northern Florida. Fresh dug plants from North Carolina, and more recently Canada, are usually set during the last 20 days of October in double row, black plastic covered, raised beds.

Table 1. Estimated 1988 commercial strawberry acreage for 12 southern states, with changes in acreage over the past 10 years and predicted changes for the near future[1].

State	Acres			Acreage Changes	
	Annual hill	Matted row	Total	Past ten years	Near future
Alabama	50	350	400	I[2]	I
Arkansas	—	400	400	D	I
Florida	5000	—	5000	S	S
Georgia	5	75	80	S	S
Kentucky	—	450	450	S	U
Louisiana	775	—	775	I	U
Mississippi	50	50	100	I	I
North Carolina	250	2450	2700	D	I,D[3]
South Carolina	40	510	550	I	S
Tennesee	40	2360	2400	I	I
Texas	90	35	125	S	S
Virginia	—	1350	1350	I	S

[1]Estimates made by strawberry extension and/or research specialist within each state.
[2]Increase (I), Steady (S), Decrease (D).
[3]Annual hill predicted to increase, matted row to decrease.

Cultivars changed often and rapidly over the past 10 years. 'Tioga' gave way to 'Tufts' in the late 1970's and the latter remained the leading cultivar for 3 to 4 years. 'Tioga' was earlier fruiting than 'Tufts,' but it had lower yields and occasional problems with small fruit size. 'Douglas' and 'Pajaro' arrived around 1982, replaced 'Tufts,' and shared the lead position until about 1985 when 'Chandler' joined the group. The soft, distorted and often split fruit of 'Douglas' proved generally unacceptable. 'Pajaro' produced large, uniform fruit, but it fruited late and was extremely susceptible to anthracnose during flowering and fruiting. 'Chandler' was susceptable to grey mold (*Botrytis cinerea*) and its large, bushy plant made control difficult. Its fruit quality was good, but on occassion it produced numerous, small fruit or fruit with non-pollinated tips.

'Pajaro' lead the 1986-1987 season followed by 'Chandler' and a new arrival 'Selva,' which claimed a small portion of the acreage. The balance changed markedly by the 1987-1988 season, however, when 'Selva' jumped into the lead claiming almost 60% of Florida's production (Table 2). This day neutral cultivar from California was selected by the industry for its very early fruit production in spite of its poor flavor and low trial yields. Economics overcame shortcomings when fruit harvested the first few weeks of December averaged $20 to $22 per flat, twice the per flat price from late December through mid-April. 'Pajaro,' followed by 'Chandler,' shared the remaining 1987-1988 market and this trend was expected to hold in the near future. The Florida native 'Dover' seemed to be making a small comeback, producing a good crop when other cultivars had little fruit. 'Dover' can generally out-yield any cultivar in an average season.

Very few strawberries have been established in neighboring southern Georgia. Populations may not have been sufficient to support direct farm sales and other market options seemed limited. In southern Alabama, however, preplant fumigation, plastic and 'Chandler' strawberry made a successful debut with "pick-your-own" producers. Annual plantings for direct marketing increased in southern Mississippi, where growers generally followed Louisiana rather than Florida cultural practices. Texas also had limited annual hill plantings of 'Chandler' and 'Pajaro.'

Louisiana maintained its well established fresh market shipping industry, which is centered primarily in the Tangipahoa Parrish in the southeastern portion of the state. 'Tangi,' released from the Louisiana breeding program in 1973, was the principle cultivar for most of the past 10 years. Abrupt changes occurred recently, however, when problems with anthracnose in local nursery plantings limited avail-

Table 2. Annual hill cultivars and their estimated percentage of 1988 acreage.[1]

	Percent of acrage				
	Chandler	Douglas	Pajaro	Selva	Other
Alabama	90%	10%			
Florida	20%		20%	60%	
Georgia	90%	10%			
Louisiana	65%	10%			Tangi (25%), Daybreak
Mississippi	•[2]	•		•	Tangi (50%)
North Carolina	80%	20%			
South Carolina	80%	20%			
Tennessee	99%				
Texas	•		•		Sequoia

[1]Estimates made by extension and/or research specialist within each state.
[2]Widely grown cultivar but percentage not estimated,

ability of 'Tangi' plants. Growers were forced to experiment with new cultivars like 'Chandler,' which was fairly successful and more attractive than 'Douglas.' 'Chandler' jumped to almost 65% of the 1987-1988 production and was expected to reach as high as 95% in 1988-1989. It was speculated that many growers, having seen 'Chandler,' may not return to 'Tangi' once plants become available.

'Chandler' also emerged as a leading new cultivar in North Carolina with the recent introduction of annual hill culture to the state. One hundred percent of North Carolina strawberries were produced in matted rows in 1982, the same year annual production research was initiated. Early studies in the southeastern portion of the state included the more traditional matted row cultivars 'Apollo,' 'Earlibelle,' 'Earliglow' and 'Titan.' It was the California releases, however, that produced the desired large, attractive fruit and high yields. With the knowledge and technology to handle the earlier flowering annual system, growers planted approximately 250 acres in 1987 with 500-600 acres expected in 1988. 'Chandler' became the leading cultivar with 80% of the production in combination with 'Douglas,' which was productive but sometimes seedy and misshapen. The very attractive 'Pajaro' was discarded because of it's poor flavor and extreme susceptibility to anthracnose.

Yields from the North Carolina annual system were not significantly higher than those of the matted row, but the fruit ripened about 2 weeks earlier and was much larger and easier to harvest. Consumer interest in "pick-your-own" strawberries had been declining but was rejuvenated with the introduction of strawberries grown on plastic. The average 4 week harvest season was also extended to approximately 6, so growers could then provide a continuous supply of shipping quality fruit for about 6 weeks. This allowed some growers to take advantage of additional market opportunities during the most recent fruiting season.

The success of the annual system in the southeastern coastal plains of North Carolina fueled interest throughout the surrounding area. Annual plantings are spreading slowly to inland North Carolina and into eastern Tennessee. South Carolina has an estimated 40 acres of strawberries in annual hill production and those are scattered across the diverse regions of the state.

Matted Row Cultivars

A broad range of cultivars are grown for matted row production in the South (Table 3). Many support small scale, localized needs but a few like 'Earliglow,' 'Cardinal,' and 'Apollo' have emerged as regional leaders.

'Earliglow,' long known for its outstanding flavor and rich, deep color, was generally ignored in the early 1980's in favor of newer, higher yielding cultivars. Now, it is the leading cultivar in Kentucky and Virginia and is gaining a larger share of matted row acreage in most states. This rise in popularity occurred perhaps, as a response to increased competition and consumer preference for earlier fruiting cultivars, which could be harvested in cooler, more comfortable weather. Growers found that early season fruit was picked clean while much of the mid- and late season fruit was left in the field. This situation made 'Earliglow' a potentially profitable cultivar in spite of it's 25-35% below standard yields. In addition, overhead sprinkler irrigation for frost protection became a more common and precise cultural practice making 'Earliglow' a more viable selection.

'Cardinal' has been the leading cultivar in northern Mississippi and Arkansas for 10 years. Five years ago, 'Sunrise' accounted for 80% of Tennessee's production, but it was replaced by 'Cardinal' which climbed from 10 to 50% of the acreage. This cultivar was recently rediscovered by many growers in the Carolinas who were im-

Table 3. Matted row cultivars and their estimated percentage of 1988 acreage.[1]

	Percent of acrage				
	Allstar	Apollo	Cardinal	Earliglow	Other
Alabama	•[2]	•	•	•	Titan, Darrow, Albritton
Arkansas			85%	5%	Arking
Georgia		•	•	•	Atlas
Kentucky	•		•	50%	Redchief, Honeoye
Mississippi			100%		
North Carolina		50%	•	•	Titan (25%), Atlas, Tennessee Beauty
South Carolina		40%	•	•	Atlas, Titan
Tennessee	•		50%	25%	Lateglow
Texas			90%		Arking, Sunrise
Virginia	•			50%	Redchief, Guardian

[1]Estimates made by extension and/or research specialist within each state.
[2]Widely grown cultivar but percentage not estimated,

pressed with its vigor, (especially from tissue cultured stock) fruit size, color and firmness. 'Cardinal' was one of the few matted row cultivars suitable for shipping, which provided an optional though limited market for some growers. It was recommended that 'Cardinal' only be planted in fumigated fields in Alabama and very well drained sites in Kentucky. 'Cardinal' accounted for 90% of the limited matted row acreage in northeast Texas.

'Apollo' has not had the widespread acceptance of 'Earliglow' or 'Cardinal' but it has been the leading cultivar in the Carolinas for about 10 years. 'Titan' and 'Atlas' have persisted as second choices in North Carolina, a position they recently lost to 'Cardinal' in South Carolina.

Other older survivors included 'Tennessee Beauty,' which is still the standard in many mountainous parts of the South like western North Carolina and northern Alabama. In Kentucky and Virginia, 'Redchief' remained as a dependable veteran. 'Earlibelle,' a common companion to 'Apollo' and a major cultivar in several states during the early 1980's, was discarded for its small, tart fruit and excessive runnering. 'Sunrise' disappeared too, mentioned only as a very small part of the acreage in Alabama and northeast Texas.

'Allstar' was consistantly mentioned as a very promising new cultivar. It produced good yields of attractive, large fruit, but its very pale flesh and poor frozen fruit quality limited acceptance in some areas. 'Honeoye' was also showing promise in the mountains of Kentucky and North Carolina.

Cultivars of the Future

The 5 strawberry breeding programs located in the South have and will continue to play a vital role in the development of well adapted cultivars for the future. Anthracnose resistant cultivars capable of producing high yields of attractive, large, high quality fruit are badly needed. Some existing strawberry industries face substantial losses if the pesticides now used for control of this disease are removed from the markets. Fortunately, progress is being made toward the long established goal of developing anthracnose resistant cultivars. A few resistant selections from the U.S.D.A. program in Mississippi are creating real excitement there and have been moved into grower trials. These selections also looked promising in Louisiana, where efforts are underway to revive the breeding program in that state.

Increased emphasis has also been placed on anthracnose resistance in the Arkansas program, which is back on track having overcome suspected viral problems at the primary breeding facility in Bald Knob. Leaf spot resistance and earlier fruiting are also major goals of that program.

Florida is expanding its program with continued emphasis on the development of high quality, anthracnose resistant cultivars. They are also looking for earlier fruiting types that would allow them to increase production during existing market windows.

The first North Carolina crosses for better adapted annual hill cultivars were made in 1986. Matted row selections are being advanced, specific crosses are being made for the mountain region and efforts have begun to combat a new race of red stele reported in the state.

Fruit Varieties Journal 43(1)38-41 1989

Eastern Canada Strawberry Cultivars

ADAM DALE[1]

Abstract

Similar strawberry cultivars are being grown throughout Canada, east of the Rocky Mountains. During the last ten years the acreage of 'Redcoat,' the predominant cultivar has declined. It has been replaced mainly by 'Kent' but also by 'Glooscap,' and 'Honeoye.' 'Veestar' has maintained its share of the acreage. The acreage of the two newer cultivars 'Blomidon' and 'Governor Simcoe' is expected to increase in the next ten years. Day-neutral cultivars will become more widely grown; 'Hecker' in western Canada and 'Tribute' and 'Tristar' in central and eastern Canada

Introduction

The strawberry cultivars grown in eastern Canada have been found to be adaptable to a wide range of environments. The same cultivars are grown in all the Provinces, east of the Rocky Mountains; that is from Alberta through to Nova Scotia.

Most of the plants are supplied by nurseries that belong to three provincial plant propagation programs, those of Ontario, Quebec and Nova Scotia. Therefore, data on the supply of plants from these programs will closely reflect the cultivar composition of the industry throughout most of Canada.

In this paper I will discuss 1) the cultivar composition of the various Canadian plant propagation programs over the last ten years; 2) the present regional variation in the cultivars and 3) possible cultivar trends for the next ten years.

Cultivar Plant Production from Canadian Propagation Programs

The percentages of the common cultivars grown in the three provincial plant propagation programs are given in Tables 1-3. Those for the Nova Scotia and Quebec programs are based on the total number of plants sold. In Ontario, the percentages are based on the number of elite plants distributed to the plant propagators. These elite plants will produce the plants that are sold two years later. Also the exact percentages of the cultivars sold will differ somewhat from the percentages distributed.

From 1977 until 1985 (1983 for the Nova Scotia program), the cultivar composition of plants supplied by the nurseries varied little. Virtually all the planting stock was of five cultivars, 'Redcoat,' 'Veestar,' 'Bounty,' 'Sparkle' and 'Micmac.' Plants supplied by Quebec were almost completely 'Redcoat' and from Ontario mostly 'Redcoat' with about 20% 'Veestar.' In Nova Scotia, approximately equal portions of 'Redcoat,' 'Veestar' and the total of the two Nova Scotia cultivars 'Bounty' and 'Micmac,' were sold.

In the early 1980's, a large number of new cultivars were introduced. 'Veegem,' 'Veeglow' and 'Vantage' from the Horticultural Research Institute (H.R.I.O.) of Ontario, and 'Kent,'

[1]Horticultural Research Institute of Ontario, Box 587, Simcoe, Ontario, N3Y 4N5 Canada.