

Midwest and Plains States Strawberry Cultivars

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The last decade has seen numerous new strawberry (*Fragaria x ananassa* Duch.) cultivars introduced for the central U.S. While a few older cultivars remain important, new plantings usually include cultivars introduced in the late 1970's and early 1980's. This decade also marked the beginning of experimental production of day-neutral strawberry cultivars, particularly in northern areas where the annual production system avoids winter injury problems.

In terms of cultivar adaptation, the region can be divided into two provinces. A northern province that includes northern Michigan and Wisconsin, Minnesota, North Dakota, South Dakota, and northern Iowa features extremely low winter temperatures (-30 to -40°C) and snow cover for 2 to 5 months and a growing season with extremely variable annual temperature and precipitation regimes.

The southern province includes southern Michigan, Ohio, Kentucky, Indiana, Illinois, Missouri, Nebraska, and southern Iowa and features a warm growing season with variable precipitation. Winter temperatures are somewhat milder (-20 to -30°C) but snow cover is typically present for only 2 months or less. Naturally, considerable climatic and edaphic variation exists in such large regions, but they do represent a framework to discuss cultivar adaptation.

The predominant marketing method in the region is pick-your-own although

pre-picked direct retail has become more important in the 1980's (10). Some Michigan and Ohio plantings are harvested for processing. Matted rows of varying width (20 to 60 cm) are still the most popular cultural system although some growers are using "ribbon rows" (10 to 20 cm spaced plants with runner removal). Narrow matted rows and ribbon rows are often grown on raised beds. Plantings are usually mulched in the late fall for winter protection. Organic mulches (straw, corn stalks, etc.) are usually used, but many growers are experimenting with synthetic rowcovers. Major production problems include winter injury, frost damage at bloom, several insects, and fruit, leaf, and root diseases.

The information on cultivar popularity and performance in this paper is drawn from published reports, unpublished reports of NCR-22 (Small Fruit and Viticulture) committee members, and discussions with scientists and growers from the region.

Predominant Cultivars

In the southern part of the region, cultivars developed by the USDA-University of Maryland breeding program are predominant. 'Earliglow,' 'Redchief,' 'Allstar,' and 'Guardian' have emerged in the last decade as the most widely planted cultivars (10, 23). In addition, 'Honeoye,' from the New York Agricultural Experiment Station has become very important. Other common cultivars include 'Midway,' 'Raritan,' 'Cardinal,' 'Scott,' 'Delite,' and

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Table 1. Strawberry cultivars introduced in 1979-1988 with potential in the Midwest and Great Plains states.

Cultivar	Year	Test No.	Parentage	Reference
Scott	1979	MDUS4376	Sunrise x Tioga	Galletta et al., 1980a
Allstar	1981	MDUS4429	MDUS4419 x MDUS3185	Galletta et al., 1981a
Lester	1986	MDUS4359	Raritan x MDUS3413	Galletta et al., 1987
Lateglow	1988	MDUS4839	Tamella x MDUS3184	
New York Agric. Exp. Stat., Geneva, NY				
Honeoye	1979	NY1409	Vibrant x Holiday	Sanford et al., 1982
Canoga	1979	NY1362	NY1123 (Senga Sengana x Midland) x Holiday	Sanford et al., 1982
Jewel	1985	NY1324	NY1221 x Holiday	Sanford et al., 1985
Agriculture Canada, Kentville, NS				
Kent	1981	K74-10	K68-58 (Redgauntlet x Tioga) x Raritan	Craig et al., 1982
Glooscap	1983	K74-12	Micmac x Bounty	Brooks & Olmo, 1983
Blomidon	1985	K76-3	K72-4 (Micmac x K68-118 (Guardsman x Tioga) x Holiday)	—
Annapolis	1985	K78-4	K74-5 (Micmac x Raritan) x Kent	—
Cornwallis	1985	K78-6	Earliglow x Kent	—
Horticultural Research Inst. of Ontario				
Vantage	1980	V7044-2	Tioga x Veestar	Ricketson et al., 1986a
Veegem	1980	V6737-1	Valentine x Fulton	Ricketson et al., 1985b
Veeglow	1980	V6782-3	Redglow x Vibrant	Ricketson et al., 1986c
Secord	1985	V7236-3	Guardian x Holiday	Dale et al., 1986
Gov. Simcoe	1985	V7236R3	Holiday x Guardian	Dale et al., 1986
Univ. of Minnesota				
Northland	1982	MN1868	Burgundy x Premier	Brooks & Olmo, 1983
Iowa State Univ.				
Mars	1983	IA6-7192	IA81-6733 x IA22-6014	Denison, 1983
Mr. Marion Hagerstrom Monticello, MN				
CrimsonKing	1981	—	—	—
Univ. of Wisconsin				
Gilbert	1982	WI7028	Cyclone x Badgerglo	Gilbert, 1982
Univ. of Arkansas				
Arking	1981	ARK6224	Cardinal x ARK5431 (MDUS3082 x Delite)	Moore, 1982

'Surecrop' while 'Lester,' 'Kent' and 'Jewel' are among the most promising new cultivars (10, 1, 23).

In the northern part of the region, cultivars developed by Canadian breeding programs are predominant. The old cultivars 'Veestar,' 'Redcoat,' 'Sparkle' and 'Trumpeter' remain pop-

ular in spite of having soft fruit. 'Redcoat' and 'Veestar' are favored in the western part of the region because of their tolerance of high soil pH. Newer cultivars that have become widely planted include 'Honeoye,' 'Kent,' 'Bounty,' 'Canoga,' 'Jewel,' and 'Glooscap.'

Table 2. Mean yields of strawberry cultivars over 3 or 4 Minnesota locations in 1983-1987^z.

Cultivar	Yield (T ^{ha} - ¹)			
	1983	1985	1986	1987
Early season				
Annapolis	---	9.9	8.5	11.7
Crimson King	8.9	11.0	6.0	11.0
Earliglow	6.1	---	---	---
Veegem	7.2	---	---	---
Veestar	7.3	9.3	6.2	---
Midseason				
Allstar	6.3	---	---	---
Cornwallis	---	7.7	6.4	10.2
Gilbert	6.7	---	---	---
Glooscap	---	16.3	17.4	17.2
Guardian	7.5	---	---	---
Holiday	6.7	---	---	---
Honeoye	12.6	6.8	10.5	17.2
Jewel	---	9.5	9.8	14.4
Kent	15.8	13.7	11.3	20.6
Lester	---	---	4.7	10.2
Northland	9.7	---	---	---
Redchief	3.9	---	---	---
Redcoat	12.5	12.7	12.7	13.8
Scott	6.9	---	---	---
Stoplight	12.2	10.2	8.7	---
Trumpeter	8.6	9.1	9.0	7.7
Vantage	6.7	---	---	---
Veeglow	8.9	10.3	5.6	---
Late season				
Badgerbelle	10.0	7.7	7.6	---
Blomidon	---	10.8	13.9	15.3
Bounty	9.7	8.0	8.9	13.9
Canoga	8.3	6.3	6.1	---
Micmac	7.2	---	---	---
Sparkle	8.6	12.7	10.4	---
Lateglow	---	---	---	11.3
lsd (0.05)	3.0	3.6	3.3	3.8

^zMeans over 4 locations (Excelsior, Morris, Grand Rapids, and Staples, MN) in 1983 and 1987 and over 3 locations (excluding Staples) in 1985 and 1986. See Luby et al., (1984) for descriptions of these locations and experimental protocol.

New Cultivars of the 1980's

Over 20 new strawberry cultivars (Table 1) adapted to the Midwest and Great Plains states have been introduced from 9 breeding programs since the last American Pomological Society

review a decade ago (16). Characteristics and performance of these cultivars in the region are described below (in the same order as they are listed in Table 1) as well as in Tables 2, 3, and 4 and previously published reports (5, 6, 7, 8, 9, 10, 22, 25, 26, 27, 28, 32, 40, 41, references listed in Table 1).

'**Scott**' produces large, attractive and very firm fruit with mild flavor. The plants are only moderately hardy and productive in northern areas and it will be best adapted to the southern Midwest from Ohio to Kansas.

'**Allstar**' has become quite popular through the southern Midwest, particularly for direct retail sales. It is vigorous, moderately productive and produces large, attractive and flavorful fruit.

'**Lester**' is a red stele resistant replacement for 'Raritan.' The fruit is very glossy and symmetrical. Winter injury is a problem in northern areas and this variety will probably only be adapted as far north as where 'Raritan' has been grown.

'**Lateglow**' has shown less winter injury in the upper Midwest than other USDA-Maryland cultivars. It is very late, extending the harvest season by 3 to 7 days. The fruit is flavorful and firm. Productivity is moderate in the north to heavy in the southern part of the region where it will probably become an important cultivar in the 1990's.

'**Honeoye**' produces medium size fruit with a tart flavor. Freezing quality is very good (27, 36). This cultivar is remarkable in having the widest adaptation throughout the region of any recently introduced cultivar (23). It has performed well from Ohio and Michigan, through Missouri, Kansas, Nebraska and north to Minnesota and Wisconsin.

'**Canoga**' is a late season cultivar with extremely firm and large fruit. It frequently suffers serious winter injury in Minnesota and will probably be better adapted in the southern Midwest.

Table 3. Mean berry weight of strawberry cultivars over 3 or 4 Minnesota locations in 1983-1987².

Cultivar	Berry weight (g)			
	1983	1985	1986	1987
Early season				
Annapolis	---	9.2	9.9	9.3
Crimson King	9.2	9.9	10.0	9.6
Earliglow	8.4	---	---	---
Veegem	8.7	---	---	---
Veestar	8.5	8.1	8.1	---
Midseason				
Allstar	10.0	---	---	---
Cornwallis	---	6.9	7.4	7.2
Gilbert	9.4	---	---	---
Glooscap	---	10.0	10.3	9.6
Guardian	9.6	---	---	---
Holiday	9.2	---	---	---
Honeoye	10.8	8.6	9.9	8.5
Jewel	---	11.2	11.1	9.5
Kent	11.9	10.3	10.3	9.9
Lester	---	---	10.3	9.7
Northland	8.7	---	---	---
Redchief	9.5	---	---	---
Redcoat	9.1	8.3	7.0	7.5
Scott	9.2	---	---	---
Stoplight	9.3	8.1	8.7	---
Trumpeter	9.0	8.3	8.5	7.7
Vantage	8.3	---	---	---
Veeglow	8.7	8.2	7.8	---
Late season				
Badgerbelle	10.9	8.8	10.7	---
Blomidon	---	11.1	12.0	9.8
Bounty	9.0	9.5	9.0	9.5
Canoga	12.2	11.5	12.0	---
Micmac	10.2	---	---	---
Sparkle	7.9	7.0	7.3	---
Lateglow	---	---	---	9.4
lsd (0.05)	1.3	1.8	1.4	1.2

²Means over 4 locations (Excelsior, Morris, Grand Rapids, and Staples, MN) in 1983 and 1987 and over 3 locations (excluding Staples) in 1985 and 1986. See Luby et al., (1984) for descriptions of these locations and experimental protocol.

'Jewel' produces very attractive, glossy, large, firm fruit. Plants are vigorous but suffer some winter injury each year in Minnesota. This cultivar will probably become important in the southern Midwest for direct retail sales

or pick-your-own where red stele is not a problem.

'Kent' already has become an important cultivar in the Midwest in the 7 years since its release. It is very productive and hardy, but is susceptible to leaf spot and shows inconsistent runner ability. The fruit is large and firm with glossy but soft skin.

'Glooscap' is rapidly becoming an important cultivar in the northern Midwest. The plants are very productive, vigorous and cold hardy. The fruit is large, firm, and dark red.

'Blomidon' produces very attractive, glossy, firm, medium red fruit with excellent texture. The plants are moderately hardy and can be very productive. This cultivar may become popular in the northern Midwest for direct retail sales as well as pick-your-own.

'Annapolis' produces large, firm light-red fruit with mild flavor. Fruit size remains large through the harvests for an early season cultivar. Winter injury has been minimal in Minnesota. This cultivar may be an additional choice for the early season in the northern Midwest.

'Cornwallis' has excellent flavor and texture from its 'Earliglow' parent. The plants have moderate productivity and hardiness. Fruit size drops rapidly after early harvests.

'Vantage' produces flavorful, glossy, medium sized fruit. It has not become popular in the Midwest, perhaps due to modest productivity and hardiness.

'Veegem' is a productive early season cultivar which has not yet been widely grown in the region. Fruit size decreases quickly through the harvest season.

'Veeglow' is a flavorful midseason cultivar which has not become popular due to its moderate fruit size and productivity (27).

'Secord' has not been as hardy, productive, or attractive as its reciprocal sibling 'Gov. Simcoe' in Minnesota trials. The cultivar has not yet been widely tested in the Midwest.

Table 4. Disease reactions² of new and certain popular cultivars in the Midwest and Plains states.

Cultivar	Red Stele ⁷	Verticillium wilt ⁸	Leaf scorch ^W	Leaf spot ^V	Powdery mildew ^U
Allstar	R	R	R-S	R-S	R-S
Annapolis	R	S	R	R	VS
Arking	R	—	R-S	R	R
Blomidon	S	VS	R	S	VR
Bounty	S	R-S	S	R-S	R-S
Canoga	S	S	R-S	R-S	S
Cornwallis	R	S	R	S	R-S
Crimson King	S	S	R	S	VS
Earliglow	R	R	R-S	S	S
Gilbert	—	—	R	—	—
Glooscap	S	—	R	VR	VS
Gov. Simcoe	—	S	R-S	—	R
Guardian	R	VR	R-S	S	R-S
Honeoye	S	S	S	R	R
Jewel	S	S	R	R	R
Kent	S	S	R-S	VS	R
Lateglow	R	VR	R-S	VS	VS
Lester	R	S	R-S	R-S	VS
Mars	—	—	—	S	S
Northland	S	—	—	VR	VS
Redchief	R	R	R	S	R
Redcoat	S	S	R	R-S	R-S
Secord	—	R	R	—	S
Scott	R	S	R	S	R
Sparkle	R	S	S	R-S	R-S
Vantage	—	R	R-S	—	R
Veegem	—	S	R	—	R
Veeglow	—	S	R	S	VS
Veestar	S	R-S	S	S	VS

²Rating scale: VR = very resistant; R = resistant; I = intermediate; S = susceptible; VS = very susceptible; R-S = variable responses in different locations/years. Ratings represent a composite of observations from 1983-1987 at 4 Minnesota locations and those of Kaps et al. (1987), Spulin et al. (1984) as well as information from the respective release notices for each cultivar (Table 1).

⁷*Phytophthora fragariae* Hickman. Cultivars indicated "R" have resistance to at least one race.

⁸*Verticillium albo-atrum* Reinke & Berth.

^W*Diplocarpon earliana* (Ell. & Ev.) Wolf.

^V*Mycosphaerella fragariae* (Tul.) Lindau.

^U*Sphaerotheca macularis* (Wallr. ex Fries) Jacz. f. sp. *fragariae*.

'Governor Simcoe' is the most promising of the 5 cultivars introduced from Ontario during the decade for either pick-your-own or direct retail sales. The fruit is very large, glossy, symmetrical and firm. Some winter injury has been noted in Minnesota. Productivity has been moderate in the northern Midwest but may prove to be heavier in the south as this cultivar is more widely tested.

'Northland' has been among the hardiest and most productive cultivars in northern Minnesota (27) and North Dakota (38). The fruit is very large, but its softness and mild flavor have limited its acceptance.

'Mars' has been a very vigorous, productive cultivar in Iowa trials (14) and hardy in Minnesota trials. The fruit is sweet, soft, and loses size rapidly through the season.

Table 5. Yield of day-neutral strawberry cultivars in an annual production system in Minnesota.

Cultivar	Yield (T•ha ⁻¹)		Berry weight (g)	
	1983	1985	1986	1987
Aptos	8.8	---	7.1	---
Burlington	---	4.0	---	10.5
Fern	8.6	4.6	8.2	7.7
Hecker	12.2	5.5	7.9	7.0
Sakuma	---	5.2	---	9.1
Selva	8.4	---	12.9	---
Tribute	11.4	5.6	7.6	7.7
Tristar	10.7	---	7.5	---
lsd (0.05)	3.0	ns	1.4	1.6

'Crimson King' is a very hardy, productive, early season cultivar which maintains its large fruit size through the harvest season. The fruit is soft and with mild flavor, but makes a high quality frozen pack (27).

'Gilbert' is vigorous and productive but only moderately firm and irregular in shape. It has not been widely grown in the region.

'Arking' produces large, medium red, glossy, firm fruit. It is a productive late season cultivar with some promise in the southern Midwest, especially where red stele root rot precludes production of 'Cardinal' and other susceptible cultivars.

Day-Neutral Cultivars

The 1980's have seen the introduction of new everbearing strawberry cultivars with more prolific production throughout the growing season than the older everbearing types. Day-neutral strawberries can potentially serve two important functions in the Midwest and Plains. They extend the season of locally available fresh fruit and they enable annual culture systems that eliminate lost productivity from winter injury.

Day-neutral cultivars were developed by the University of California (Bringhurst and Voth, 1980), USDA-Maryland (20), and Sakuma Farms,

Inc. breeding programs. A *F. virginiana* ssp. *glauca* Staudt. genotype collected by R. S. Bringhurst in the Wasatch Mountains of Utah was the initial source of the day-neutral trait. With repeated backcrossing to some of the best short-day genotypes, day-neutral cultivars with commercially acceptable fruit size and firmness were developed.

Experience with day-neutral strawberries in the Midwest and Great Plains is still limited and optimum best production systems and areas of adaptation are yet to be determined. Productivity can vary considerably in among years and locations (Table 5, and (29)). Day-neutral cultivars seem to have larger yield and fruit size in northern parts of the region where extreme heat that suppresses flowering is rarely encountered (15). Productivity and other traits of these cultivars as grown in the Midwest are summarized below and in Tables 5, 6 and 7, as well as in previously published reports (3, 4, 20, 29, 30).

'Aptos' (1979, Univ. of California) was among the first day neutral cultivars introduced. Its susceptibility to leaf and fruit diseases in the region and its lack of plant vigor, fruit size and quality have precluded its widespread use in the region.

'Brighton' (1979, Univ. of California) has large, firm fruit but a lack of fruit quality and disease susceptibility have also precluded its use. 'Brighton' was reported to be sensitive to alkaline soils in Colorado (32) and North Dakota.

'Hecker' (1979, Univ of California) was also sensitive to alkaline soils in Colorado (32) and Minnesota. It is also susceptible to fruit rots. In spite of these faults and small fruit size, it has been very productive and is the only one of the University of California original day-neutral cultivars to be grown on even a limited commercial basis in the Midwest.

'Fern' (1982, Univ. of California) has higher quality fruit than the other University of California introductions. It

Table 6. Relative ratings^z of day-neutral strawberry cultivars for plants in Minnesota.

Cultivar	Winter injury	Plant vigor	Leaf spot ^y	Leaf scorch ^x	Powdery mildew ^w
Aptos	4	1	1	1	4
Brighton	2	3	4	2	3
Burlington	3	5	4	4	3
Fern	3	2	1	2	4
Hecker	3	3	2	1	3
Sakuma	3	3	3	3	5
Selva	1	5	4	4	5
Tribute	4	4	3	4	5
Tristar	4	4	2	2	3

^zRating scale ranges from 1 to 5 for each trait. Rating of 5 indicates minimal winter injury, high plant vigor, or minimal disease infection for the respective traits. Ratings represent a composite of observations from 1983-1987 at 4 Minnesota locations.

^y*Mycosphaerella fragariae* (Tul.) Lindau.

^x*Diplocarpon earliana* (Ell. & Ev.) Wolf.

^w*Sphaerotheca macularis* (Wallr. ex Fr.) Jacz. f. sp. *Fragariae*.

has not become popular because of disease susceptibility and lack of vigor. It has shown slight iron chlorosis on alkaline soils in western Minnesota.

'Selva' (1982, Univ. of California) has exhibited severe iron chlorosis on alkaline soils in Minnesota, North Dakota, and Colorado (32). The fruit is very firm and attractive but lacks flavor. 'Selva' has the largest fruit size of all day-neutral cultivars and for this reason has been widely grown. Productivity has been modest as it is considered the "weakest" of the available cultivars in day-neutral flowering habit.

'Tribute' (1981, USDA-Univ. of Maryland) has probably become the most popular day-neutral cultivar in the region. It has been productive and relatively resistant to most diseases. The fruit is large, firm, and flavorful, though somewhat acidic. Iron chlorosis has not been observed on 'Tribute' or 'Tristar' in Minnesota.

'Tristar' (1981, USDA-Univ. of Maryland) is similar to 'Tribute' in many plant traits. The fruit is probably the most flavorful and attractive of all the day-neutral cultivars, but its smaller size has made 'Tristar' a second choice to 'Tribute' for many growers.

'Burlington' (1985, Sakuma Farms, Inc.) produces large firm fruit and is more resistant than the California cultivars to diseases in the region. It has exhibited iron chlorosis in North Dakota but not in western Minnesota. It has not yet been widely tested but may have promise in the Midwest.

'Sakuma' (1985, Sakuma Farms, Inc.) also has not yet been widely tested in the region. The fruit is firm but of modest size and mild flavor. Plants are not vigorous and are susceptible to leaf diseases.

In 1987, the University of California introduced 3 new day-neutral cultivars 'Yolo,' 'Mrak,' and 'Muir.' These have not yet been tested in the Midwest.

Current Strawberry Breeding for the Region

Several breeding programs are currently producing new cultivars for the Midwest and Plains states. The USDA program at Beltsville, MD under the direction of G. J. Galletta and A. D. Draper is the focus for much of this activity. This program is continuing to develop high quality, productive cultivars with resistance to red stele and verticillium wilt for the lower Midwest. The USDA program has expanded in the 1980's to serve the upper Midwest through cooperative programs with the University of Wisconsin and the University of Minnesota. This program aims to Junebearing and everbearing cultivars that combine red stele resistance with cold hardiness and high fruit quality for direct and local marketing with processing options.

Several Canadian programs should be producing new cultivars with adaptation to the Midwest and Great Plains. The Agriculture Canada program in Kentville, Nova Scotia is breeding for cold hardy, productive, red stele resistant cultivars. The program in at the Horticultural Research Institute of Ontario (HRIO, at Simcoe) will be intro-

Table 7. Relative ratings of day-neutral strawberry cultivars for fruit traits in Minnesota.

Cultivar	Attrac- tiveness	Firm- ness	Texture	Flavor	Fruit rot
Aptos	3	5	2	2	1
Brighton	2	4	2	2	1
Burlington	4	4	2	3	4
Fern	3	5	4	3	1
Hecker	3	4	3	2	2
Sakuma	3	4	2	2	3
Selva	5	5	2	1	3
Tribute	3	4	4	3	4
Tristar	4	4	4	4	4

²Rating scale ranges from 1 to 5 for each trait. Rating of 5 indicates a high level of attractiveness, firmness, texture (mouth feel), flavor, or minimal fruit rot (*Glomerella cingulata* (Ston.) Spauld. & Schrenk). Ratings represent a composite of subjective observations from 1983-1987 at 4 Minnesota locations and in sensory evaluation panels (Luby et al., 1987).

ducing productive, verticillium wilt and powdery mildew resistant cultivars, with high quality fruit suitable for fresh market or processing and, in some cases, mechanical harvest.

At the University of Arkansas, the breeding program has been reduced but is trying to develop a very early ripening cultivar that would be similar to 'Cardinal' in fruit and plant traits. A program has been initiated at Ohio State University with a major goal of developing cultivars with high quality fruit for processing. The Iowa State University program under E. L. Denisen is continuing to evaluate selections with adaptation to the central Midwest. The breeding program at the New York Agricultural Experiment Station has been at least temporarily discontinued. The private breeding program of Marion Hagerstrom and his associates in Minnesota is shifting its emphasis to day-neutral types in addition to cold hardy Junebearing types. The region can expect new day-neutral cultivars from several other sources including the University of California, the USDA (Beltsville, MD), North Dakota State University (Fargo) and the HRIO program at Simcoe.

Cultivars for the 21st Century

Although several breeding programs in the region have been discontinued or scaled down in the last two decades, the remaining programs still offer prospects for further improvements in strawberry cultivars. The genotypes these programs are evaluating now will become the predominant strawberry cultivars of the 21st century. What will be needed in these cultivars? Better quality will be paramount. The preponderance of the two-income family with less leisure time and more disposable income has led to the stabilization of the pick-your-own market and increased demand for high quality, pre-picked berries. The Midwestern strawberry producer also faces competition from the supermarket where numerous high quality deciduous and sub-tropical fruits are conveniently available from both the northern and southern hemispheres. The season extension offered by day-neutral cultivars will provide a product for certain growers to face this competition.

Discontinued registration or production of agrichemicals will need to be accompanied by increased concentration on breeding for pest resistance. We already have witnessed the beginning of the trend toward the loss of pesticides due to concerns about toxicity and environmental damage. Biological control of diseases and insects through the use of resistant varieties will become ever more important. Likewise, the loss of herbicides and fumigants may necessitate new cultural systems for weed control such as allelopathic companion crops or ribbon row plantings mulched with polyethylene or other materials. New short-day and day-neutral cultivars may be needed to take full advantage of these systems.

These trends, and the ever present need for high productivity and fruit size, ease of harvest, cold hardiness, and heat tolerance will insure that the cyclical rise and decline in popularity

of strawberry cultivars in the Midwest and Plains states will continue.

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Northeastern United States Strawberry Cultivars

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The Region and its Strawberry Needs

For the purpose of this discussion, we shall consider the northeastern U.S. to be the Middle Atlantic States—New York, Pennsylvania, New Jersey, Maryland, Delaware, Virginia and West Virginia, and the New England States—Connecticut, Massachusetts, Rhode Island, Vermont, New Hampshire and Maine.

This area generally has sufficient rainfall over a very diverse array of topographical situations, soils and microclimates. Although many of the regions' cultivars are tolerant of numerous pathogenic fungi, most of them require some chemical pest control. Persistent fungus problem diseases are red stele, verticillium wilt, leather rot, gray mold, leaf scorch, leaf blight, powdery mildew and black root rot complex. Preplanting soil nematocide treatments are generally recommended, as are postplanting insecticides for the aphid vectors of virus diseases, for strawberry clipper, lygus bugs, sap beetles and a variety of chewing insects.

Cultural System and Market Outlet Shifts

Ten years ago the region produced fruit, from mostly matted rows, almost exclusively for the pick-your-own and roadside market trade. A relatively few strawberry specialty farms were producing berries on raised beds with close planted, spaced matted rows and experimenting with chemigation and planting time and distance variations. Weed control and renovation techniques were being used which extended profitable planting life to five years and more. Demand for the product was strong, prices were good and production was increasing rapidly.

A series of difficult winters in the early 1980's led to plant shortages, the use of nursery plants from outside the producing region and some increased disease and cultivar identity problems. Evidently permanent population shifts (like the increase in two wage earner families), a series of early and very warm harvest seasons, overproduction, and reduced price differential between customer-harvested and retail outlet

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