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Raspberry Genotypes for the East Coast

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Abstract

The changes in raspberry cultivars planted in the eastern U.S. were determined from a 1987 grower survey as compared to a partial survey of Cooperative Extension Service and Agricultural Experiment Station recommendations over the last two decades. As future changes will be dependent on cultivars bred for the rigorous climatologic conditions specific to the region, the results and progress of the three eastern raspberry breeding programs are also summarized.

Limitations to Production

Temperature is the major limitation to raspberry production in the eastern U.S. East of the Appalachian Mountains (i.e. at elevations of less than 300m); native stands of red raspberries (*R. idaeus var. strigosus)* occur only above 41° N latitude. Accordingly, red raspberry production in the South is limited to the Appalachian highlands; however, from VA northward, production also occurs in the Piedmont and Coastal Plains. Black raspberries *(R. occidentalis)* are found north of Georgia. In the NY and New England growing regions, midwinter temperatures in raspberry growing areas (near the Great Lakes and Atlantic Ocean) typically reach -20°C. From southern PA and NJ to GA, midwinter minimum temperatures are milder; from -18°C to -10°C. Typically temperatures are about 5°C colder in the Appalachians. Frequent mid-winter episodes of subtropical air masses from the Gulf of

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Mexico result in premature dehardening and late-winter bud break in several genotypes. The initial autumnal hard freezes (-7°C) also may cause damage as the area often experiences warm temperatures until late November. Summer temperatures are moderate in the north (25°C), but they frequently exceed 32°C (> 50% of the summer days) from mid PA southward.

The pests common to the eastern states are as varied as the climatological conditions. From southern PA northward and in the Appalachians, aphids *(Amphorophora)* (and mosaic viruses) and *Botyrtis* fruit rot are common pests. Further south, aphid populations may be limited by mid-summer heat and *Botrytis* is more episodic and related to rainfall patterns. Several species of leaf hoppers, mites and cane borers can severely reduce cane growth. Late leaf rust *(Puccinia-strum)* of red raspberries and orange rust of black raspberries, when they occur, can severely restrict production. Cane *(Leptosphaeria)* and spur *(Didymilla)* blight are found throughout the region. *Colletotrichum gloesporioides* can also cause cane blight in North Carolina. Recent field investigations of Tomato Ringspot Virus and *Phytophthora* root rot indicate these may be important in reducing plant stand and yield through-out the eastern U.S.

Although these limitations have caused a major decline in eastern raspberry culture over the last century, interest in this crop has increased in the last decade. No comprehensive surveys were found indicating relative acreages of different cultivars over the last 30 years primarily because the industry was geographically diffuse. In an effort to determine cultivar and industry trends, state Cooperative Extension and Agricultural Experiment Station recommendations were surveyed. This information was compared to a survey of growers taken in 1987.

Genotype Recommendations

Typical cultivar recommendations from Cooperative Extension Services and Agricultural Experiment Stations have changed over the past two decades (Table 1). The cultivar listings of Michigan-1989 and NE-1990 (1) were not specific recommendations. Listed cultivars were those which had the highest cumulative ranking based on the character assessments used in each production guide. Those cultivars which have consistently been recommended are 'Heritage,' 'Boyne,' 'Latham,' 'Reveille' and 'Taylor.' More recent recommendations are 'Amity' and 'Redwing' fall bearing red raspberries and 'Canby,' 'Royalty' and several of the newer spring bearing red raspberry genotypes from the British Columbia and northwestern U.S. breeding programs. Southern recommendations include 'Dormanred' and 'Heritage' for the far South and 'Reveille,' 'Citadel,' 'Cherokee,' 'Heritage' and 'Pocahontas' for the mid-Atlantic states. 'Mandarin' may be a good replacement for 'Dormanred' in some areas.

Black raspberry recommendations have consistently been: 'Allen,' 'Black Hawk,' 'Bristol,' 'Cumberland,' and 'Dundee.' Recently a productive and sweet black raspberry, 'Haut' (MD-134J), has been widely planted and recommended. 'Haut' has only average fruit size but its harvest season tends to be a little longer than most black raspberry cultivars.

NABGA Grower Survey

In 1987, a survey was sent to the 210 members of the North American Bramble Growers Association (2). Growers were asked to list the acreages of the cultivars planted and the traits which distinguished the performance of each cultivar. Yield and relative fruit size information was also requested. Fifty three surveys were returned representing 353.1 acres of raspberries. The results were divided into two

Table 1. Raspberry cultivar recommendations from various Cooperative Extension Service and Agricultural Experiment Station bulletins. Fall bearing cultivars are in capitals.

Bulletin State-Year	Red Raspberry Genotypes
NH-1975	DURHAM, EARLIRED, FALLRED, Gatineau, Latham, SEPTEMBER, Taylor.
WI-1980	Boyne, FALLGOLD, FALLRED, HERITAGE, Latham, Liberty, Reveille, Sentry.
RI-1980	FALLRED, HERITAGE, Hilton, Latham, Milton, Taylor
ARK-1986	Dormanred, HERITAGE
GA-1987	Dormanred, HERITAGE, Latham
NY-1987-1991	HERITAGE, Reveille, Newburgh, Taylor, Titan, Royalty, Boyne
OH-1988	AMITY, Boyne, Brandywine, Festival, HERITAGE, Hilton, Latham, Liberty, REDWING, Reveille, Royalty, Sentry, Titan
Mich-1989	AMITY, Boyne, Canby,* Haida,* HERITAGE, Latham, Newburgh, REDWING, Reveille, Skeena,* Taylor, Titan.*
NE-1990	AMITY, Boyne, Canby,* FALLRED, HERITAGE, Killarney, Latham, Newburgh, REDWING, Reveille, Royalty, Taylor
NJ-1991	HERITAGE, Latham, Newburgh, REDWING, Reveille, Titan
NC—1991**	Bristol, CHEROKEE, Citadel, HERITAGE, Mandarin, Reveille, Royalty
PA-1991	AMITY, HERITAGE, Hilton, Latham, Liberty, Newburgh, Reveille, RUBY, Sentry, Taylor, Titan
MD-1991	CDH-1, CHEROKEE, Citadel, HERITAGE, Pocahontas, Reveille

*—only half hardy for the region according to Mich-1989 and NE-1990. Mich-1989 and NE-1990 (1) recommendations are rankings of the cumulative scores given the cultivars in comparisons of various phenotypic traits (e.g., size, hardiness, etc.).
**NC-1991 information supplied by Dr. J. Ballington, NC State University at Raleigh.

regions, North (213 acres-primarily NY, Ontario, New England, MI and MN) and South (140 acres-primarily PA, MD, NJ, VA, DE, OH). The average age of the planting was 3 years. The oldest plantings on an operation averaged 5.5 years.

Results of the most commonly grown cultivars are indicated in Table 2. Average grower yields were given for some cultivars. The fall crop of 'Heritage' on East Coast farms averaged 3000 lbs/acre (2.7 mT/ha). The spring crop averaged 6,700 lbs/acre (5.9 mT/ha). The spring crop of 'Boyne' (primarily grown in Canada and MN) averaged 3,800 lbs/acre (3.3 mT/ha). Royalty averaged 3,700 lbs/acre (3.3 mT/ha) while 'Bristol' black raspberry averaged 2,500 lbs/acre (2.2 mT/ha). 'Canby,' 'Bristol,' 'Heritage' and 'Boyne' fruit are considered "medium" sized by the growers. 'Titan,' 'Royalty' and 'Brandywine' fruit are considered "large" to "very large." More than one grower indicated that 'Allen' black raspberry was hard to pick, 'Titan' was susceptible to cold temperatures and *Phytophthora*, and 'Taylor' was powdery mildew susceptible. Around 60% of the acreage in this survey was Pick Your Own, the rest was hand harvested for fresh fruit markets. Growers indicated that fresh marketing and, in the southern area, Pick Your Own were marketing channels which would be expanding in the near future. Only two growers (both in Canada) indicated their acreage of raspberries would be smaller in the future.

Current Breeding Programs

A majority of the cultivars listed in both tables have been produced by eastern breeding programs, for example: 'Heritage,' 'Titan,' 'Ruby,' 'Royalty,' 'Jewel' and 'Brandywine' (NY), 'Cherokee' and 'Pocahontas' (VA) and

Table 2. Results of NABGA grower survey with total acreages in parentheses as listed by region.

	Raspberry Type		
	Red		
Region	Spring	Fall	Purple & Black
North	Boyne (67) Comet (20) Titan (17) Royalty (16) Sentry (5) Canby (4) Festival (4)	Heritage (51) Amity (4)	Brandywine (11)
Mid-Atlantic & South	Royalty (5) Hilton (3) Dormanred (2) Latham(2) Titan (2) Boyne (2) Taylor (1)	Heritage (28)	Bristol (33) Jewel (25)

'Sentry,' 'Reveille,' 'Citadel' and 'Reveille' (MD). However, the use of cultivars adapted to Canadian climates in the South, e.g. 'Latham' and 'Boyne,' and the relatively low yield and fruit firmness and/or size obtained by eastern growers, are indicative of the need for improved genotypes. Future cultivar trends would be expected to be determined by the direction and germplasm used in current regional breeding programs. Three eastern U.S. raspberry breeding programs have existed with some interruption for over 50 years. At all locations, breeding has intensified recently as the popularity of this crop has increased. The primary goals of these programs are plant survivability and productivity for regional markets. Specific approaches are listed below.

1. The Maryland/Virginia So. Piedmont Agric. Expt. Sta./Rutgers/Univ. of Wisconsin Cooperative Breeding Program. On average, over 6000 seedlings are planted each year spread among 4 sites. In order to increase selection pressure, seedlings are grown with minimal or no pesticide applications and two sites are infested with *Phytophthora sp.* Crosses are primarily between eastern U.S. cultivars (best parents: 'Titan,' 'Reveille,' 'Southland') and those from the Pacific NW (best parents: 'Skeena,' 'Willamette,' 'Amity') or Scotland (best parents: SCRI 30C2 & 8216B6, 'Glen Moy' 'Glen Prosen'). As red raspberries are not native to much of the region, other *Rubus* species have been useful in raspberry backcrossing schemes, including: *R. flos-culosis* (extreme vigor, productivity, cane disease resistance and erectness), *R. lasiostylus* (fruit cohesiveness, aphid resistance, low sap beetle counts, excellent vigor and productivity, moderate size, possible fruit rot resistance), *R. parvifolius* (productivity and vigor), *R. phenocolasius* (yellow color) and *R. pileatus* (fruit rot resistance, flavor). Other species of less use or which are presently being evaluated include: *R. calcinoides, R. chamaemorus, R. hirsutus, R. innominatus, R. leucodermis, R. pungens oldhamii* and *R. stellarcticus* (flavor).

Several blackberry x synthesized tetraploid red raspberry crosses have been made. Tetraploids are synthesized by immersion of in vitro shoots in liquid medium with 5 mM colchicine for 24 hours followed by two 10-day cultures on agar-solidified Murashige and Skoog proliferation medium. Apical leaves are excised and placed on Murashige and Skoog medium with 5

μM thidiazuron for shoot organogenesis (3). Up to 13% of the regenerated shoots have homogenous (non-chimeral: based on root sucker observation) tetraploid phenotype.

Several black raspberries (SCRI 30C2, 'Black Knight,' 'Dundee') have been crossed with red fall bearing types to produce primocane bearing purple and purple-red raspberries. These types produce fruit on short primocanes that arise from crown or basal buds. The use of these genotypes for producing very early primocane crops is being tested.

2. The Cornell University Raspberry Breeding Program at Geneva, New York. Annually an average of 3,000 raspberry seedlings are planted in Geneva. Currently seven acres of seedlings are grown and evaluated under low spray conditions. There has been no perennial aphid or root rot resistance pre-screening of seedlings to date, but some screening should be implemented in the near future. Most sites, if not all, are naturally infested with *Phytophthora*. 'Latham,' 'Meeker' and 'Nordic' are the most tolerant parental cultivars to this root rot disease. The parents which have recently been the most successful in terms of number of selections are: NY 141 (large size and yield), NY 978 (early primocane fruit), NY 72 and NY 78 (purple, primocane fruiting for quality), NY 1009 (quality, primocane fruiting) and NY 164 (purple). 'Titan,' 'Royalty' and 'Heritage' have been good parents in the past, 'Ruby' has not proven to be a good parent.

Advanced floricane fruiting selections are NY 7, NY 135 and NY 138. Advanced primocane fruiting selections are NY 118 and NY 1009. 'Reveille,' 'Canby,' 'Royalty,' 'Titan' and 'Heritage' have been accepted by local growers, with increasing interest in 'Summit,' 'Redwing,' 'Nordic' and 'Schonemann.' Replicated trials with 'Titan' on raised beds are very promising; this treatment performs better than 'Titan' on level ground with metalaxyl applications. Recently, a new evaluation block with over one hundred *Rubus* cultivars and selections, and a new screenhouse for the maintenance of virus indexed stock, have been established. Virus testing assistance and full time staff have been restored.

3. The North Carolina State University Raspberry Breeding Program has been especially proficient at collecting and utilizing native and foreign germplasm. Breeding is aimed , to a degree, at producing cultivars to use in the Appalachian Highlands.

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Ozone Impact on Tree Fruit

Almond were more sensitive to ozone that peach or apricot. Foliar injury on almond occurred and growth was reduced. Apricot showed little foliar injury but developed a thinner trunk and more shoots than the untreated plants. Exposed peach trees had fewer shoots and thicker trunks.

From: McCool, P.M. and R.C. Musselman, 1990. Impact of ozone on growth of peach, apricot and almond. *HortScience* 25:1384-1385.