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**Red Raspberry
Trials 1994-1997**

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SUMMARY

The productivity and fruit size of 10 red raspberry cultivars were compared in a single replicated trial. The goal was to identify cultivars with commercial potential that would extend the harvest season for red raspberries and improve on the yield and small fruit characteristics of the well-established fall cultivar Heritage. Plots were harvested for yield and fruit characteristics for 4 years (1994-1997). Two high-yielding cultivars with fruit size larger than Heritage and ripening characteristics which would extend the productive season in Connecticut were identified. Killarney is a high yielding summer cultivar and Autumn Bliss is a high-yielding fall cultivar which ripens 2-3 weeks earlier than Heritage. Thus, red raspberry production in Connecticut may start with Killarney, continue with Autumn Bliss, and finish with Heritage.

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Commercial red raspberry production in Connecticut is focused on direct local sales through pick-your-own and farm outlet operations. High establishment and labor costs are partly overcome by situating production close to population centers where there is an abundance of pick-your-own consumers. Because raspberries are highly perishable and command a high market price, they are ideally suited to direct local sales. In 1986 a survey by John Elliston of the Experiment Station found 33 farmers growing raspberries on approximately 42 acres. The survey showed about 86% were red raspberries (*Rubus idaeus*) with 71% of the red raspberries represented by the "everbearing" cultivar 'Heritage' which was managed for fall production. The cultivar situation has not changed much since 1986; although more growers are testing newer cultivars on a limited basis. A raspberry cultivar testing program was initiated in 1987 to provide Connecticut farmers with information they could use in making cultivar and cultural decisions for new plantings (Stephens and Kiyomoto 1990).

Two publications, Bramble Production Guide (Pritts and Handley (eds.) 1989) and Raspberry Management (Crandall and Daubeny 1990), provide comprehensive reviews on the biology, cultural practices, and pests involved in raspberry production. In addition, the Bramble Production Guide provides a chapter on enterprise budgeting which should be considered by potential growers. Initial investments can be high and returns slow. Raspberry biology and management information used in this Bulletin is from the Bramble Production Guide (Pritts and Handley 1989).

Raspberries are perennial plants that produce biennial canes. Canes, normally vegetative the first season, are called primocanes. Primocanes emerge each year. A primocane will become reproductive, producing flowers and fruit, in its second growing season and is then called a floricanes. The floricanes dies after fruiting. Pruning involves the removal of the dead floricanes and excess primocanes. The most productive floricanes are those of greater diameter and the most fruitful buds are those in the middle 3/5 of the cane. Thus, for high productivity, cultural practices should aim at producing large primocanes and removing the smaller primocanes. Red raspberries (*Rubus idaeus*) have the ability to spread and fill in

space between the original plants because they can develop primocanes from root buds. In contrast, black raspberries (*Rubus occidentalis*) arise only from crown buds and therefore tend to remain where originally set.

One group of red raspberries has the ability to produce fruit on the growing tips of primocanes and has been referred to as "everbearing" or fall raspberries. In this group, the primocanes grow a certain number of nodes that behave in the normal biennial fashion. However, the growing tip will change from the vegetative state to reproductive state so fruit is set at the upper nodes. Since the ability to flower develops late, the fruit are usually produced in late summer or fall. The lower part of the primocane does not become reproductive until the following year when it behaves as a normal floricanes, fruiting in the summer and dying after fruiting. Thus, with a mixture of primocanes and floricanes, a summer and fall crop can be produced. However, in Connecticut the everbearing raspberries are usually managed for fall production because the crop is usually larger and pruning is greatly simplified. Pruning for fall production involves cutting all the canes back to ground level in late winter. Because this removes any future floricanes, all regrowth will be primocanes which will produce a crop in late August until frost.

The cultivar Heritage grown for a fall crop represents the principal cultivar used by Connecticut growers and gardeners. Several commercial growers also use the cultivar 'Titan' for summer fruit production; however, previous trials (Kiyomoto 1993) showed Titan suffered considerable decline in stand after the third or fourth year of growth. Titan is known to be susceptible to phytophthora root rot, but its decline in our previous trial occurred in soils which were well-drained, unfavorable sites for phytophthora disease development. The trial results reported here were initiated to continue the testing of commercially available cultivars, but the goal was more specific. Since most red raspberry production occurs in the fall, the goal was to extend the harvest season for red raspberries in Connecticut. Thus, the goal was to identify commercially acceptable cultivars which would increase summer production and cultivars which might bridge the period between the end of summer production and the beginning of fall production.

METHODS AND MATERIALS

A single trial was established at Lockwood Farm, Hamden on Cheshire fine sand loam, a well drained loamy upland soil with a moderate moisture holding capacity. Ten cultivars were planted in a randomized complete block design with each cultivar represented by one 25 ft row in each block. There were four blocks or replications, and rows were spaced 12 ft apart. At planting on May 18, 1991, plants were placed 18 in apart within each row. Drip irrigation aided initial establishment and insured adequate moisture when summer dry periods exceeded 7 days. A thin layer of wood chip mulch was applied on June 3 to help prevent excessive drying. Table 1 summarizes the cultivars, their source, and type of planting material used. Ideally, the same type of planting material would have been used; however, in order to obtain the additional cultivars desired, alternative planting stock was secured. Tissue culture plants were indexed as virus free. Nursery matured plants were virus indexed tissue cultured plants that were grown for one season in the field. Bare root plants make no claims as to virus status of the propagating material. Autumn Bliss was replanted in Spring 1992 due to losses among the small tissue culture plants.

Table 1. Red raspberry cultivars compared, the source, and type of planting material used.

Cultivar	Source	Planting Material
Amity	North Star Gardens	Bare Root
Autumn Bliss	North Star Gardens	Tissue Culture
Summit	North Star Gardens	Tissue Culture
Nordic	Nourse Farms, Inc.	Nursery Matured
Killarney	Nourse Farms, Inc.	Nursery Matured
Redwing	Nourse Farms, Inc.	Nursery Matured
Citadel	Nourse Farms, Inc.	Nursery Matured
Cherokee	Nourse Farms, Inc.	Nursery Matured
Titan	Nourse Farms, Inc.	Nursery Matured
Heritage	Nourse Farms, Inc.	Nursery Matured

A 122 cm wide weed-free zone in the planted rows was maintained in years after planting with single early spring applications of Surflan, spot applications of Roundup, and manual weeding. Fertilizer was broadcast in the raspberry and weed-free zone as a split application of 159 kg per hectare (350 lb per acre) 10-10-10 in May and again in early July. No fungicides, nematicides, or insecticides were applied throughout the study.

Pruning and thinning of fruiting canes of summer raspberries was done in two stages. In the summer and fall, dead fruiting canes and small diameter, diseased, and broken primocanes were pruned at ground level and removed from the plots. In late winter or early spring before bud break, fruiting canes were thinned to 3 to 5 of the largest diameter canes per 30.5 cm of row. "Everbearing" raspberries were managed for a fall crop by cutting all canes at ground level in late winter

or early spring. All cut canes were removed from the plots. Canes were trained to a wide trellis with the cane hedge allowed to spread to a width of 61 cm at the ground and 91.5 cm at the upper retaining wires (Kiyomoto 1993).

Yields were determined by continuous harvesting of all the ripe fruit in two 1 m sections of each plot. In 1997, some cultivars had declined and the stand was spotty so harvests were made only within one 1 m section of each plot. No harvesting was done over weekends, so pink fruit were harvested on Friday and the final weight of the pink fruit was estimated from average fruit weight determined from the ripe fruit. Such continuous harvests allowed us to approximate the maximum marketable yield under the conditions of the trial. Small, rotten, or virused fruit were not counted as marketable yield. Data recorded were date of harvest, yield, and average fruit weight. Qualitative notes were taken on fruit firmness and flavor.

RESULTS AND DISCUSSION

Table 2 summarizes the yield and fruit size characteristics of the 10 cultivars compared over the 4 years of study. In this table, cultivars are ranked according to yield and not by summer or fall bearing categories. Previous studies (Kiyomoto 1993) showed Heritage managed as a fall crop was consistently highest yielding. The results in Table 2 show Autumn Bliss the highest yielding cultivar. It also has good fruit size, but it did not have a significantly greater yield than Heritage. Cherokee also produced excellent yields, but it had small fruit similar in size to Heritage. Killarney was the highest yielding summer red raspberry in the trial. Along with Autumn Bliss, Killarney had significantly larger fruit than Heritage.

Table 2. Overall Yield and Fruit Size 1994-1997.

Cultivar	Season	Mean Yield* kg/Ha	Mean Size (g/fruit)
Autumn Bliss	Fall	4,744.3 a	2.44 bc
Heritage	Fall	4,259.4 ab	1.72 d
Cherokee	Fall	3,755.4 bc	1.73 d
Killarney	Summer	3,016.2 cd	2.43 bc
Amity	Fall	2,838.1 cde	1.98 cd
Summit	Fall	2,749.6 de	1.69 d
Red Wing	Fall	2,704.8 de	1.70 d
Nordic	Fall	2,634.2 de	1.95 cd
Titan	Summer	1,923.0 e	4.02 a
Citadel	Summer	1,153.6 f	2.75 b

*Numbers followed by the same letter in a column are not significantly different by Duncan's Multiple Range Test (P=0.05).

Figure 1 shows the yearly yield of the summer cultivars in the trials, 1994-1997. The yield of all summer cultivars was significantly reduced in 1997 due to an infestation of cane borer which killed a majority of the fruiting canes dur-

ing ripening (Fig. 1). No attempts were made to control disease in order to detect differences, if any, in resistance. The premature death of floricanes in summer cultivars resulted in great yield losses. The fall cultivars also had cane borer, but the loss of several primocanes in the summer was compensated for by other primocanes which were in great excess.

Because of different fruit ripening periods of cultivars and the focus on identifying cultivars for continuous raspberry production from summer until first frost, they were grouped accordingly. Although damaged by raspberry cane borer, Titan initially developed a good stand, but after the first year of harvest the stand declined continuously. Yield of raspberries which started ripening in the late summer and continued producing marketable fruit into the fall are shown in Fig. 2. In this group, Autumn Bliss had a consistently high yield. Summit showed a loss of stand as the trials progressed and a significant proportion of the plants became stunted with crumbly, small fruit which were discarded. While Red Wing produced fruit of acceptable size, firmness, and flavor, it yielded significantly less than Autumn Bliss.

Among the late fruiting cultivars (Fig. 3), Heritage was the highest yielding every year. In 1996 the yield of Heritage was prematurely terminated by an epiphytotic of botrytis fruit rot or else it probably would have exceeded Autumn Bliss for yield that year. Cherokee also has a reasonably high yield; however, Cherokee suffers from being an even later maturing cultivar than Heritage. Thus, yield of Cherokee was also terminated prematurely in 1996 by botrytis fruit rot, and the yield of Cherokee is often cut short by frost.

In earlier trials, 1988-1992 (Kiyomoto, 1993), it was noted that seasonal conditions can have great effect upon raspberry yields. Exceptional yields were seen in 1991 when warm autumn temperatures and the long length of harvest combined to give an excellent yield. In contrast, in 1992 it was cool and moist throughout the summer and fall. The harvest interval in 1992 was long, but the cool, moist summer and fall did not favor good flowering. In normal years, it is usually the first hard frosts that terminate harvest of the fall crop. In the earlier trial, Heritage was best among the red raspberry cultivars tested. However, it was speculated that a cultivar which ripened a few weeks earlier than Heritage would probably increase yield by extending the harvest season and offsetting loss due to early frosts. In the current trials conducted over the years 1994-1997, Autumn Bliss illustrated the advantage of earlier maturity. Autumn Bliss consistently had the highest yield and also had larger fruit than Heritage. However, the peak yield of Autumn Bliss may not continue under favorable conditions of a mild late October and November. In a mild late fall, Heritage would continue to produce and, therefore, have the potential to exceed the yield of Autumn Bliss. Heritage continues to be the leading

cultivar for late production, and has a long record of being a reliable standard for productivity in Connecticut.

Table 3 summarizes the mean start and finish days for harvest and harvest interval from 1994 to 1997. Unexpectedly, Nordic produced fruit in the summer and fall; however, its yield was always poor. For the 1997 season, Nordic was managed for a fall crop only, but this did not increase its productivity.

In summary, the current trials identified two productive cultivars, Killarney and Autumn Bliss, which can be used with Heritage to extend the crop season in Connecticut. New cultivars will continue to be evaluated for productivity, fruit size, firmness, flavor, and pest (i.e., phytophthora root rot, botrytis fruit rot, raspberry cane borer) resistance in order to increase the cultivar options of Connecticut producers.

Table 3. Mean start and finish days and harvest intervals for red raspberry cultivars, 1994-1997.

Cultivar	Harvest		Interval (days)
	Start	Finish	
Killarney	June 30	July 31	31
Titan	July 4	July 28	24
Citadel	July 5	July 26	21
Nordic	July 5	Oct 25	112
Autumn Bliss	July 24	Oct 11	80
Summit	Aug 4	Oct 10	64
Redwing	Aug 7	Oct 10	63
Amity	Aug 13	Oct 24	71
Heritage	Aug 18	Oct 21	63
Cherokee	Aug 27	Oct 28	62

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REFERENCES

- Crandall, P.C. and H.A. Daubeny. 1990. Raspberry management. pp 157 - 213. *In*: Galletta, G.J. (ed.) Small fruit crop management. Prentice Hall, Englewood Cliffs, N.J.
- Kiyomoto, Richard K. 1993. Raspberry trials 1988-1992. CT Agr. Expt. Sta., New Haven Bulletin 913. 8 p.
- Pritts, M. and D. Handley (eds.). 1989. Bramble production guide. NARES-35. Northeast Regional Agricultural Engineering Service, Ithaca, New York.
- Stephens, G.R. and R.K. Kiyomoto. 1990. Raspberries: a revived crop for Connecticut farms. Conn. Agr. Expt. Sta., New Haven. *Frontiers of Plant Science* 43(1):2-4.

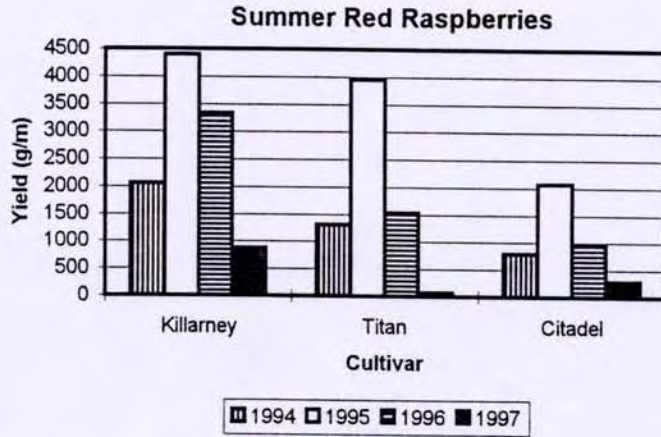


Fig. 1. Yield of Summer red raspberries

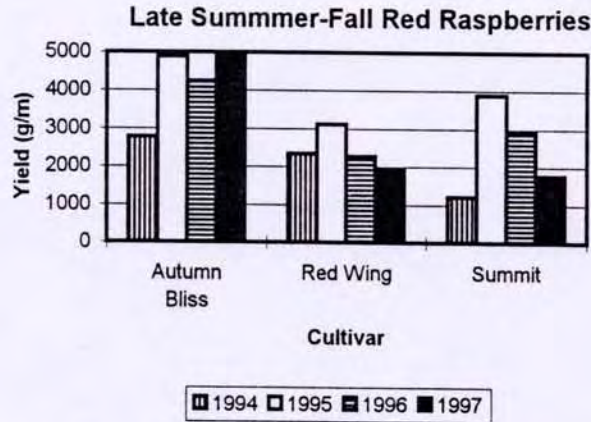


Fig. 2. Yield of fall red raspberries, Autumn Bliss, Red Wing, and Summit which overlap production with summer red raspberries.

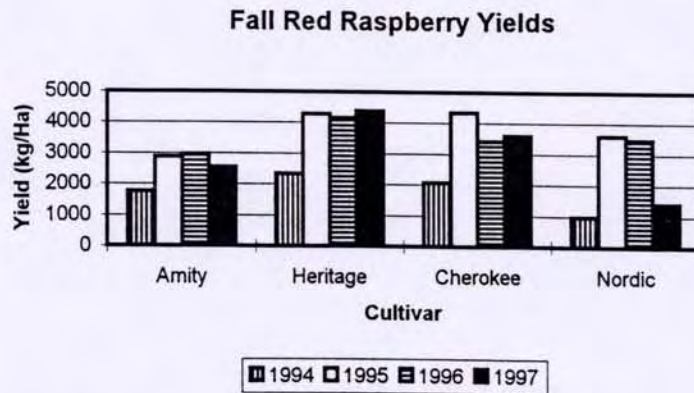


Fig. 3. Yield of fall red raspberries, Heritage, Amity, Cherokee, and Nordic.



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