

## Fruit Yield and Solar Injury Comparison of Two Primocane Fruiting Red Raspberries<sup>1</sup>

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### Abstract

Primocane fruiting red raspberry (*Rubus idaeus* L.) cultivars 'Heritage' and 'Amity' were compared for two seasons, 1985 and 1986, in terms of fruit yield. In 1986 they were also compared for susceptibility to solar injury of fruit (failure of some drupelets to develop red color). 'Heritage,' currently the only commercial cultivar, out-yielded 'Amity,' which proved poorly adapted to Colorado conditions. 'Amity' showed significantly less solar injury of fruit, suggesting that red raspberry cultivars do differ in susceptibility.

Fresh market raspberry production based on the primocane fruiting (PF) cultivar 'Heritage' (4) has recently become important in several parts of the U.S. A Colorado raspberry industry existed prior to 1940 (1, 3) but then disappeared due to market and labor problems. Biennial cane cultivars are currently unsuitable due to poor winter survival of buds unless labor intensive cane protection is practiced. Loss of buds is apparently due to fluctuating winter temperatures, low humidity, and lack of snow cover at most sites. Early plantings of 'Heritage' in western Colorado have shown promise, although many sites are prone to early fall freezes which cause large yield reductions. A preliminary 1983 trial of several PF cultivars (unpublished) found none of equal or greater suitability than 'Heritage.' The PF cultivar 'Amity' released in 1984 by F. J. Lawrence, USDA, Corvallis, Oregon, begins fruiting several days earlier than 'Heritage' under Pacific Northwest conditions, a trait of particular importance in Colorado. Since acreage is

low but increasing rapidly, the time is opportune to determine which cultivar is preferable.

Despite the observed tendency for lower cane vigor and fruit yield in Colorado than elsewhere and a problem with solar injury to fruit (5), a variable raspberry industry is possible due to good market access and acceptance and relatively high prices. This study compared fruit yield for two seasons and measured solar injury of fruit for the cultivars 'Heritage' and 'Amity.'

### Materials and Methods

'Heritage' and 'Amity' raspberry plants were set at the Orchard Mesa Research Center on 25 April and 30 April, 1984, respectively, in a Genola clay loam soil, pH 7.3. Plants were spaced 45 cm apart in rows 3.05 m apart. Fertilization consisted of pre-plant incorporated phosphorus and soluble nitrogen applied through the drip irrigation system three times per season. Standard weed and pest control practices were used.

The planting consisted of five rows, 47 m long. The border rows and the south 31 m of the three interior rows were 'Heritage,' while the north 16 m of interior rows were 'Amity.' Yield data were taken from five plots of each cultivar, all in the three inner rows. Plots were 3 m long in 1985 and 2.5 m in 1986. A non-randomized design was used in the replicated statistical analysis which compared cultivars. An un-

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paired t test was used with the understanding that what was being compared was the combined effect of cultivar plus site. No soil gradient was apparent and plots of the two cultivars were only separated by 5-30 m. Tensiometers indicated no soil moisture gradient along the rows. Total irrigation plus rainfall from 15 April to 22 October 1986 was 161 cm. Yields were recorded by weight (g) in 1986, but by volume (half pints) in 1985. The 1985 yields were converted to grams following statistical analysis, assuming an average weight of 140 g per half pint. Comparative yields for the two years are expressed as kg per ha. The 1985 harvest season included 23 picking dates from 14 August to 10 October. There were 21 harvest dates in 1986 from 24 August to 14 October.

The procedure to measure solar injury included placing a 2.5 m stake in each 1986 yield plot so that five canes per plot could be tied into an upright position, exposing fruit to the sun. The tips of an additional five canes were tied down within the canopy so the fruit was shaded during most of the day. The percent of berries on these canes which exhibited solar injury (white drupelets) was calculated from the fruit harvested on 5 and 8 September. The exposed vs. canopy-shaded fruit response was analyzed by paired t test using a randomized complete block design within a given cultivar. The two cultivars were compared for each treatment using the same analysis and assumptions as for the yield data.

### Results and Discussion

'Heritage' produced greater fruit yield than 'Amity' in both the second and third season of the planting (Table 1). The closeness of the two sites, the lack of apparent soil and moisture differences, and the uniformity of growth within each cultivar all support the conclusion that this yield difference was real, despite the inability to use a randomized design in the com-

**Table 1. Fruit yield in 1985 and 1986 from a 1984 planting of 'Heritage' and 'Amity' red raspberries in Colorado.**

Cultivar	Fruit Yield (kg per ha)	
	1985 <sup>z</sup>	1986
Heritage	4591 b <sup>y</sup>	6750 b
Amity	2161 a	3964 a

<sup>z</sup>Data in 1985 were converted from volume units to weight after statistical analysis to allow comparison between years (see text).

<sup>y</sup>Mean separation for each column by unpaired t test ( $P = 1\%$  in 1985,  $P = 5\%$  in 1986).

parison. Cane number and vigor were visibly greater for 'Heritage' as was green color of leaves. 'Amity' leaves had a scorched appearance, similar to two spotted mite injury. Fruit harvest began earlier than normal in 1985 and later than normal in 1986, but in neither year did 'Amity' ripen a commercially harvestable quantity of fruit earlier than 'Heritage.' This contrasts with its behavior in a marine climate (2), and may reflect the above vegetative problems in these climatic or soil conditions. 'Amity,' therefore is not a suitable replacement for 'Heritage' in Colorado sites which have had a problem with early fall freezes.

The major production problem in the first half of the harvest season is the solar injury disorder, which necessitates a costly sorting procedure (5). Since no commercial preventive practice has yet been developed, a determination of susceptibility differences among cultivars is needed. Preliminary observations with the red raspberry cultivars 'Heritage,' 'August Red,' 'Trailblazer,' and 'Pathfinder' indicated that the disorder occurs in all of them. Black raspberries, which have a different pigment makeup, have not shown symptoms of solar injury.

In this study shading reduced solar injury of both 'Heritage' and 'Amity' fruit (Table 2, columns). However, exposed 'Amity' fruit showed significantly less damage than 'Heritage' (Table 2, top row). This indication of genetic variation means it may be

**Table 2. Percent fruit with solar injury in sun-exposed vs. canopy-shaded positions for both 'Heritage' and 'Amity' red raspberries. Cultivar differences are compared across rows.**

Treatment	Heritage	Amity
Percent Solar Injured Fruit		
Sun-Exposed	46.0 b <sup>1</sup> d <sup>2</sup>	27.5 b c
Canopy-Shaded	13.5 a c	8.0 a c

<sup>1</sup>Mean separation within columns (a, b) by paired t test (P = 1%).

<sup>2</sup>Mean separation across rows (c, d) by unpaired t test (P = 1%).

possible to identify or develop cultivars which are less vulnerable to solar injury.

The cane positioning procedure made it possible to study an additional aspect of solar injury. The greatest extent of solar injury previously recorded was 44% of fruit on some dates in 1985 (5). It was unclear whether the undamaged fruit included fully exposed berries, which would suggest that the intensity of solar injury factors was inadequate, or if all such fruit were protected by partial canopy shading. The percent injury did not increase on fruit of highly exposed 'Heritage' canes in 1986 (Table 2) compared to 1985, but conditions also differed. The later than average initial ripening in 1986 occurred when daily air tempera-

ture maxima were only 27-33°, compared to 33-37° during the first two weeks of harvest in 1985. It seems likely that 46% is not the upper limit of damage for exposed fruit, but a definite conclusion will require another test at higher temperature.

'Heritage' will continue to be the cultivar of choice in Colorado, but should be planted with awareness of site limitations in relation to early freezes and the need for special handling when conditions favor solar injury.

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## ANNUAL MEETING

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