Rooting capability may be maintained by severe pruning (1) and, recently, rooting capability has been recovered in plants of O.3 propagated from the adult phase by meristem culture (H. A. Quamme and E. J. Hogue, unpublished data). Although loss of rooting capability during growth phase transition may be prevented by pruning and may be recovered once lost, it is an undesirable characteristic in rootstocks. A number of rootstocks did propagate well in this study. These may have the best potential for commercial use and may also be useful as parents in future rootstock breeding programs.

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The Interaction Between Fruit Size and Yield in Sweet Cherry

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Abstract

The size of 'Bing' cherries is negatively related to yield where leaf area is relatively constant. Data from three years with light, moderate, and heavy yields and six pruning treatments of varying severity produced a regression line where y = 9.7 - .0062x with r = -.95 where y = grams per cherry, x = kg per tree. Since leaf area was relatively constant, this relationship demonstrates the effect of L:F ratio on fruit size. Cherry cultivar evaluation can be improved by recognizing this relationship. Even crude estimates of L:F, plotted against fruit size, separated cultivars that produced large fruit with heavy yields from those that did not.

Introduction

New cultivars are usually described as having large fruit, or fruit of a particular diameter, weight or volume (1, 2, 3, 4, 8). However, fruit size can vary for many reasons but depends primarily on leaf area per fruit (7, 9). When size and yield data are available, the influence of differences in leaf area per fruit on fruit size usually is ignored or sometimes misinterpreted. A method to compare the size of fruits from different cultivars at the same leaf:fruit ratio (L:F) would be useful, especially when yields vary widely due to environmental conditions. Determining L:F is cumbersome in the field. Yield per tree can be determined readily and can serve as a first approximation of L:F, especially if tree size and vigor are relatively constant. With young bearing trees yield per unit trunk cross-sectional area is a useful representation of relative leaf area. This paper presents data from four

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sweet cherry studies on the relationship between fruit size and yield per tree and suggests ways to use this relationship to extract more information from cultivar trials and other quantitative plot work.

Materials and Methods

Study No. 1 uses 'Bing' trees on Turkish Mahaleb rootstock planted in 1963. Crop levels ranging from light to heavy were obtained from annual dormant pruning to six treatments. Eighteen one-tree replicates were used. Yields were obtained as kg per tree. Yield data were obtained for 1986, 1987 and 1989. In this mature orchard, leaf area is assumed to be relatively constant from year to year regardless of pruning treatment.

Study No. 2 uses 'Rainier' and 'Bing' trees on Turkish Mahaleb rootstock planted in 1963. Three treatments were used: 1) control, 2) trees thinned by pruning off heavily set branches 10 days after bloom, and 3) gibberellic acid (GA) applied at 20 ppm 40 days after full bloom. There were seven one-tree replicates in this experiment. Yields were obtained in kg per tree.

In study No. 3, 14 selections from the WSU cherry breeding program are compared with 'Bing' in a randomized block with 10 one-tree replicates. The trees are on Mazzard rootstock with Montmorency interstem. Yield of each tree was estimated in May on a scale where 0 = no crop, 1 = light crop, 2 = good crop, 3 = full crop, 4 = overcropped and 5 = severely overcropped.

Study No. 4 uses a block of 42 selections on Mazzard rootstock with Montmorency interstem, three trees per selection, not randomized. Yields were estimated in the same manner as in planting No. 3.

In each study a fruit sample was collected from each tree by selecting one branch, then harvesting every cherry until the 200-300 fruit sample was obtained. The samples were collected when the average color approached dark red (No. 33 comparator, British Columbia Research Council). Fruit size was measured as the mean weight per cherry of 50 unblemished cherries of uniform color.

For study No. 1, the mean yields per tree for 1986, 1987 and 1989 were regressed against the corresponding mean weights per fruit (Fig. 1). The line calculated from these data was used to evaluate cultivar, GA and thinning effects (Fig. 2). Similar treatment of studies 3 and 4 plotted yield ratings against weight per fruit.

Results and Discussion

In study No. 1, fruit size was closely associated with yield per tree (Fig. 1). The regression line is $y = 9.7 - .0062x$ with $r = -.95$, where y = grams per cherry, x = kg per tree. This relationship is helpful in comparing cultivars, treatments and other variables. Fruit size was not an independent characteristic. Size and yield will not be negatively related in all data sets. If a data set includes trees that vary in vigor, a common occurrence in field data, both size and yield may increase with increasing vigor. The data in Figure 1 were averaged from replicates whose vigor was proportional to soil depth. Each replicate produced a regression line more or less parallel to that in Figure 1 (similar slopes) but with y-intercepts that varied widely. If all the individual data were plotted, the r value would be very low. It is necessary to examine the data in a manner that will assure a good estimate of the true relationship between L:F and fruit size. In this case L:F was varied by varying F while L remained constant and vigor differences were averaged.

The ability to reach a given fruit size with a given L:F is a characteristic of a cultivar under a standard set of growing conditions (Fig. 2). 'Rainier' produces larger cherries than does 'Bing.' Control 'Rainier' produced cherries that were 2 g larger than 'Bing' at

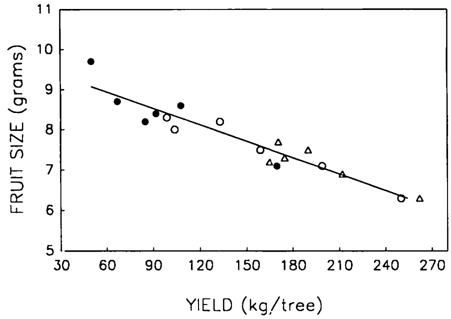

Figure 1. Fruit size in relation to yield per tree for 1986 (○), 1987 (●), and 1989 (Δ), 'Bing' cherries.

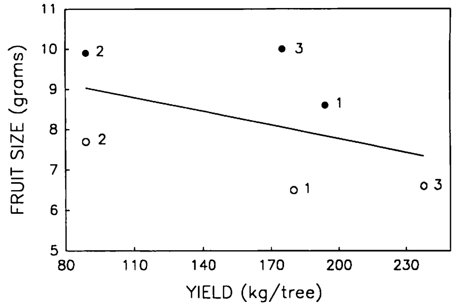

Figure 2. Fruit size in relation to yield per tree; control (1), thinned (2), and GA (3) for 'Bing' (○), and 'Rainier' (●) cherries compared to regression line from Figure 1.

a similar yield per tree. Thinning the crop to reduce yield by half increased size of both cultivars but 'Rainier' was still 2 g larger than 'Bing.' GA normally increases cherry fruit size (5). In 1989, GA increased the size of 'Rainier' but not of 'Bing.' The 'Bing' trees treated with GA bore a heavier crop than 'Rainier' trees. By adjusting fruit size along the slope of the yield-size regression line to equal yields, it is clear that GA also increased the size of 'Bing' cherries. Comparable analyses can be applied to cultivar tests.

Yield records are often not available from cultivar or selection tests. Most evaluators use a rating scale for yield. Such a rating probably estimates L:F more than yield per tree. In study No. 3, plotting L:F ratings against fruit size gives a distribution that suggests a negative relationship between L:F and size (Fig. 3). Since it is known that such a relationship is true, one can estimate or calculate a reasonable regression line. It is not essential that the line be precise. Selections that produced high yields of large fruit can be identified. Rating of L:F may not be linearly related to true L:F as is suggested in Figure 3. This and other sources of error preclude definitive anaysis but can be managed.

Cultivar tests, and particularly tests of selections, are not always replicated. In study No. 4, the non-randomized test block of 42 selections was also analyzed on a L:F estimate/fruit size

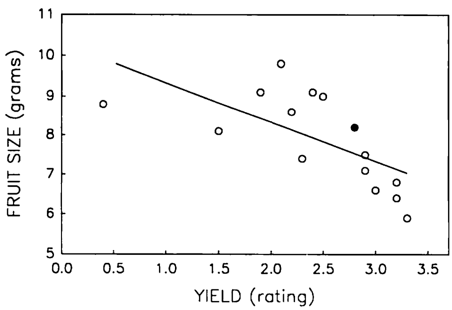

Figure 3. Fruit size in relation to estimated yield per tree in a randomized block test of 14 sweet cherry selections (○), compared with 'Bing' (●).

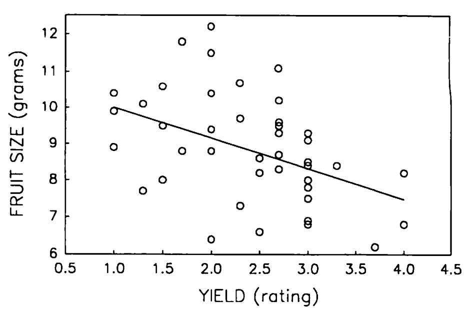

Figure 4. Fruit size in relation to estimated yield per tree in non-replicated test of 42 sweet cherry selections, 3 trees per selection.

plot (Fig. 4). A regression line allows decisions to be made about promising selections.

A fruit size index can be developed by adjusting sizes to what they would be at constant yield or L:F, such as 100 kg or a L:F rating of 3. Perhaps a large-fruited selection is large because fruit does not set well and the tree never reaches a L:F rating of 3. This also is important information about the selection.

Since sweet cherries continue to grow after they first become sufficiently mature for fresh market harvest, it is important to harvest at a comparable, advanced maturity. Skin color of dark sweet cherries is the best criterion (6).

This relatively simple procedure improves cultivar evaluation. It utilizes measured fruit size, L:F ratios that may be estimated in several ways, and the physiological principle that L:F ratios largely determine fruit size.

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Influence of Rootstock on Response of 'Delicious' and 'Golden Delicious' Trees Treated with Paclobutrazol

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Abstract

Mature 'Golden Delicious' and 'Red Prince Delicious' on seedling, MM.106, MM.111 or M.7 rootstocks were treated with a high or low dosage of paclobutrazol by trunk crown drench in April 1985. Dosage varied with rootstock according to a hypothetical amount of natural growth reduction relative to trees on seedling rootstock. Length of current seasons growth of shoots was measured over the next 4 growing seasons. In the year of application treatment had no effect. The following year, terminal shoot length on both cultivars receiving the higher dosage was significantly less than controls and was controlled to the same degree on all 4 rootstocks. In the second and third years after treatment, differences among rootstocks became more apparent.

Managing vegetative growth of fruit trees is a challenge to fruit growers throughout the world. Many methods have been used to control tree growth including training, pruning, scoring, size-controlling clonal rootstocks, and chemicals.

The use of [(2RS,3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazole-1-yl)pentan-3-ol] (paclobutrazol, PBZ, [ICI Americas, Goldsboro, NC]) to control vegetative growth of fruit trees has been investigated for many years with varying degrees of success. Fac-

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