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Bud Distribution and Yield Potential in Peach

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Abstract

One year old shoots of 50 cultivars of peach (*Prunus persica* (L.) Batsch) differing in genetic and geographic origin were studied. Bud density and distribution showed marked differences among genotypic groups. Cultivars originating in climates with less risk of low winter temperatures generally had lower bud densities based on a high proportion of blind nodes or nodes with only one bud. Higher bud densities were associated with a higher proportion of nodes with 3 buds which generally results in higher flower and fruit densities that would require more labor for thinning.

Fruit yield is a complex trait that is influenced by such factors as climate and management practices (1, 4, 7) as

well as by genetic differences among genotypes (3, 10) and by the genotype-environment interaction (5, 9). Some phenotypic factors influencing yield of perennial crops have been reported. For blueberries, Siefker and Hancock (11) observed that the most important factors associated with yield were the number of canes per bush, followed by the number of berries per cane. The main yield components for sour cherries were the number of 4 year old limbs per tree and fruit set (4) whereas in 3 pear cultivars studied by Kappel (6), yield was associated with fruit set and fruit growth.

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Generally, description of peach cultivars are based on morphological and phenological data which indirectly influence yield (1, 2, 5). However, there is a lack of information about the influence of some factors that might be more directly associated with yield. Identification of such factors might allow a more efficient differentiation of cultivars and seedlings in the search for higher yielding genotypes in a breeding program.

Flower buds on one-year-old shoots are the basis for next season's crop in peach and the number of flower buds per node on a shoot is a relatively constant trait among cultivars (3, 12). Peach cultivars from Eastern U.S. breeding programs, where low winter temperatures and spring frosts are generally a limiting factor for peach production, have a higher proportion of flower buds per node when compared with California cultivars (12). Byrne (3), attributed the higher yielding stability of 'Texstar' peach under the harsh Texas environment to its high flower density. Previous work on shoot morphology has not described bud distribution among the nodes nor the fate of flower buds as it relates to their potential for fruit set.

The main objectives of this study were to determine: 1) The difference in bud number and distribution along one-year-old shoots, as well as in flower, fruit and shoot densities among a wide range of peach genotypes differing in genetic and geographic origin; and 2) associations among traits

Materials and Methods

This study was performed at the Istituto Sperimentale per la Frutticoltura-Rome (ISF) in Italy, during the 1991 growing season. Fifty peach cultivars in a variety test block that was planted in 1985 were selected in order to provide a wide range of germplasm differing in geographic and genetic origin (Table 1).

Ten 1-year-old shoots were sampled on four trees per cultivar two weeks

before bloom. The shoots were randomly chosen around tree canopies at a height of 1.2 to 2 m. The following data was recorded: shoot length, number of nodes with 0, 1, 2, or 3 unopened flower or leaf buds. During blossom, the number of flowers per shoot length (fl/sl) were counted. Seven to 8 weeks later, the number of fruits and vegetative shoots were counted. From these data, 13 variables were calculated: bud distribution based on the proportion of nodes with 0, 1, 2 or 3 unopened buds per shoot length (b/sl) and buds per node (b/n), flowers per shoot length (fl/sl) and flowers per node (fl/sl), fruits and number vegetative buds breaking and growing, fr/sl and s/sl respectively. As well as the proportion of buds opening as flowers (fl/b), fruit set (fr/fl) and number of shoots to number of fruits (s/fr) ratios.

Cultivars were grouped according to mean values registered for each individual variable, and the correlations among variables were calculated using mean values for each variable and cultivar.

Results and Discussion

All traits studied exhibited wide variability among varieties (Tables 2, 3 and 4). The proportion of blind nodes was especially high for 'Goodmans choice' and 'Prof. Black,' 28.1 and 48.6%, respectively (Table 2), but low for 'Adriatica' (3.1%) and 'Br2' (3.4%).

Some of the most important cultivars recently released from California breeding programs show high proportion of nodes with one bud (Table 2), such as 'Elegant Lady' (79%), 'Independence' (73.7%), 'Springcrest' (73.3%), 'Goldcrest' (66.9%) and 'Flavorcrest' (66.1%), similar in this respect to the 2 Spanish cultivars included in this study, 'Calanda' (70.5%) and 'Bajo Aragon' (89.6%), and the South African cultivar 'Prof. Black' with 50.1%. All of these cultivars exhibited low values for nodes with 3 buds and bud densities as expressed by the number of buds per

Table 1. List and origin of peach cultivars studied.

Cultivar	Origin	Cultivar	Origin
Adriatica	Italy/USA	María Serena	Italy/USA
Aldrichi	Brazil	Merrill Pacifica	W-USA
Allgold	E-USA	Michellini	Italy
Armking	W-USA	Nectaross	Italy/USA
Bajo Aragón	Spain	NJC 112	E-USA
Balkmi Josaeng	Korea	O'Henry	W-USA
Br2	Brazil	Perc. Sanguinello	Italy
Br3	Brazil	Pi7620001	Italy
Calanda	Spain	Pillar	E-USA
Carson	W-USA	Platicarpa A	Italy/USA
Comp. Redhaven	E-USA	Prof. Black	South Africa
Convenio	Brazil	Redhaven	E-USA
Elegant Lady	W-USA	Sangdo	Korea
FA7-4N	E-USA	Seaboksunga	Korea
FA8-7N	E-USA	Sett. Turca	Turkey
Flavorcrest	W-USA	Shen Shou Mitao	China
Goldcrest	W-USA	Silver Prolific	W-USA
Goldilocks	E-USA	Springcrest	W-USA
Goodmans' Choice	W-USA/S-Africa	Sunfre	W-USA
Grezzano	Italy	Tebana	Italy/USA
Harrow Diamond	Canada	Villa Ada	Italy/USA
Herrington	W-USA	Villa Adriana	Italy/USA
ISF7310902	Italy	Villa Doria	Italy/USA
Independence	W-USA	Villa Giulia	Italy/USA
Maria Aurelia	Italy/USA	Yumyeong	Korea

node (b/n) and buds per shoot length (b/sl). Those cultivars with a high proportion of nodes with 0 and one bud, are from Mediterranean climates and represent a relatively compact group against genotypes with a higher proportion of nodes with 2 and 3 buds, which originated from colder regions with lower winter and/or early spring temperatures and are represented by cultivars like 'Balkmi Josaeng,' 'Sangdo,' 'Allgold,' 'Goldilocks,' 'NJC-112' and 'Yumyeong.'

This work confirms the observations made by Werner et al. (13) which suggest a genetic basis for the differences in flower buds per node among peach cultivars. Some genotypes such as 'Prof. Black,' with a high proportion of blind nodes, are very similar in this respect to other selections derived from the same germplasm sources (8).

The majority of cultivars exhibited a higher proportion of nodes with 1

bud, followed by the nodes with 3 buds and 2 buds (Table 2), but it is possible to separate 3 broad classes with respect to bud distribution: 1) genotypes with more than 60% of nodes with 1 bud from Mediterranean climates, with 'Springcrest,' 'Independence,' 'Flavorcrest,' 'Calanda' y 'Bajo Aragón'; 2) cultivars with more than 30% of their nodes with 3 buds such as 'Balkmi Josaeng,' 'Villa Doria' y 'Sangdo,' originated from colder regions; and 3) cultivars with a relatively more uniform bud distribution in all three node categories, which includes 'Allgold,' 'Yumyeong' and 'NJC112.'

Bud density (b/sl), ranged from values as low as 47.8 b/sl in 'Prof. Black' to higher than 100 in 'Balkmi Josaeng,' 'Yumyeong,' 'Redhaven,' 'Pillar,' 'Br2,' 'Br3,' 'Convenio,' 'Seaboksunga' and in the dwarf cultivar 'Silver Prolific' with the highest value (247b/sl).

Table 2. Bud distribution of 50 peach cultivars as observed at the ISF, Rome, Italy in 1991.

	Percent of nodes with					Percent of nodes with			
	no buds	1 bud	2 buds	3 buds		no buds	1 bud	2 buds	3 buds
Adriatica	3.1	34.2	21.2	41.4	María Serena	6.2	44.0	21.8	28.0
Aldrichi	9.1	38.3	27.8	24.8	Merrill Pacifica	13.7	56.6	12.0	17.7
Allgold	5.8	36.6	22.9	34.6	Michellini	4.4	48.4	14.4	22.9
Armking	9.7	60.1	17.5	11.9	Nectaross	4.5	55.7	18.2	21.6
Bajo Aragon	5.2	89.6	3.9	1.3	NJC112	4.9	38.0	27.8	29.4
Balkmi Josaeng	5.7	28.1	11.4	54.6	O'Henry	12.4	59.6	21.9	6.3
Br2	3.4	51.1	11.2	34.3	Perc. Sanguinello	13.2	47.2	15.2	15.6
Br3	5.3	37.3	29.3	28.1	Pi7620001	19.6	34.2	20.5	25.6
Calanda	19.7	70.5	3.8	6.0	Pillar	11.5	39.0	18.7	30.8
Carson	5.9	55.8	15.4	7.2	Platicarpa A	16.7	43.0	17.3	22.9
C. Redhaven	3.5	52.0	18.5	26.0	Prof. Black	46.8	50.1	1.3	0.9
Convenio	15.3	34.0	19.2	31.5	Redhaven	4.1	55.7	11.7	28.5
Elegant Lady	5.3	79.6	8.5	6.6	Sangdo	8.1	29.9	21.9	39.9
FA7-4N	7.8	47.0	21.3	23.8	Seaboksunga	4.9	41.5	26.3	27.3
FA8-7N	17.2	49.0	16.7	17.2	Sett. Turca	7.2	48.3	16.4	28.0
Flavorcrest	11.1	66.1	15.2	7.6	Shen Shou Mitao	11.3	88.7	0.0	0.0
Goldcrest	16.5	66.9	10.0	6.5	Silver Prolific	6.6	39.1	23.8	30.4
Goldilocks	11.3	35.1	23.2	30.3	Springcrest	7.2	73.3	11.6	7.8
Goodmans Choice	28.1	71.9	0.0	0.0	Sunfre	4.5	67.3	10.9	17.3
Grezzano	13.2	56.3	17.2	13.2	Tebana	7.2	54.7	17.5	20.5
Harrow Diamond	7.5	44.9	22.0	25.8	Villa Ada	15.8	69.3	11.2	3.7
Herrington	16.7	57.4	13.2	12.7	Villa Adriana	5.0	53.2	19.0	22.8
IF7310902	4.3	51.1	36.8	7.9	Villa Doria	8.8	36.1	15.8	39.2
Independence	9.8	73.7	8.2	8.2	Villa Giulia	7.2	45.0	14.9	32.8
María Aurelia	13.3	74.0	9.4	18.6	Yumyeong	4.2	36.6	27.4	31.4

The data on b/sl closely reflects the values for b/n, with almost the same genotypes registering either high or low numbers (Table 3). However, b/sl is a better indicator to single out standard against short internode peach genotypes, as in 'Silver Prolific,' which does not differ from other genotypes with respect to bud distribution (type 3, more uniform) but as expected due to its short internodes, it registered extremely high values for bud and flower densities, and showed average proportion of buds breaking into flowers (fl/b).

A semidwarf genotype such as IF7310902 exhibits a higher proportion of nodes with 2 buds, but it ranks slightly above average for bud and flower densities.

There are 3 cultivars selected under Brazilian subtropical climates, 'Con-

venio,' 'Br2' and 'Aldrichi,' all with high bud densities but with very low flower densities, due to high bud dropping during bloom. This is probably the result of a lack of acclimatization to a more temperate climate, as a result of the lower winter temperatures that are common in Central Italy. However, other selections from Brazil ('Br3') or from subtropical regions in the Southern US (FLA7-4N and FLA8-7N from Florida), seem to tolerate the low winter temperatures better. This suggests that genetic differences exist and are important in determining further adaptation.

More than 15 correlations between the 13 variables studied were highly significant (Table 5). The proportion of blind nodes was found to be negatively related with the number of buds per node ($= -0.62$), while the propor-

Table 3. Bud and flower densities along one-year old shoots on 50 peach cultivars studied at the ISF, Rome, Italy in 1991.

	b/n	fl/n	b/sl	fl/sl	fl/b
Adriatica	1.9	1.10	94.6	54.5	57.6
Aldrighi	1.7	0.12	95.4	8.9	9.3
Allgold	1.9	1.06	94.5	54.0	57.1
Armking	1.3	0.65	81.2	46.1	53.3
Bajo Aragon	1.0	0.59	60.7	31.9	52.5
Balkmi Josaeng	2.2	1.58	106.0	67.5	63.4
Br2	1.7	0.12	106.0	7.7	7.3
Br3	1.8	1.16	105.0	67.5	64.3
Calanda	1.0	0.57	59.0	33.9	57.4
Carson	1.6	0.72	88.8	40.5	57.8
C. Redhaven	1.7	0.82	98.5	46.3	47.3
Convenio	2.0	0.39	107.0	21.4	20.0
Elegant Lady	1.2	0.76	69.5	43.6	65.8
FA7-4N	1.6	0.84	113.0	63.7	51.9
FA8-7N	1.3	0.78	84.8	43.5	58.1
Flavorcrest	1.2	0.59	59.2	31.0	51.5
Goldcrest	1.1	0.63	57.1	33.0	57.8
Goldilocks	1.7	0.97	83.0	46.0	59.3
Goodmans Choice	0.7	0.31	48.0	23.1	43.1
Grezzano	1.3	0.76	84.1	45.6	54.2
Harrow Diamond	1.7	0.93	78.4	44.3	56.1
Herrington	1.2	0.76	86.0	48.5	60.7
IF7310902	1.5	1.05	97.2	69.1	71.0
Independence	1.2	0.70	71.1	40.3	59.8
Maria Aurelia	1.0	0.52	72.9	34.2	51.1
Maria Serena	1.1	0.96	78.4	46.1	60.3
Merrill Pacifica	1.3	0.73	79.2	42.2	54.7
Michelini	1.4	0.69	62.0	30.2	48.4
Nectaross	1.6	0.88	82.3	45.8	55.6
NJC112	1.8	1.13	81.7	50.9	62.3
O'Henry	1.5	0.64	72.7	35.2	48.4
Perc. Sanguinello	1.5	0.86	80.3	45.8	57.0
Pf7620001	1.5	1.00	91.2	56.8	62.3
Pillar	1.7	1.07	120.0	76.6	63.8
Platicarpa A	1.5	1.02	94.2	56.1	75.6
Prof. Black	0.6	0.39	47.8	26.1	68.9
Redhaven	1.7	0.93	105.0	53.2	51.2
Sangdo	1.9	1.25	84.7	54.7	64.5
Seaboksunga	1.8	1.44	105.0	78.2	81.5
Sett. Turca	1.7	1.16	105.0	63.6	62.3
Shen Shou Mitao	0.9	0.13	51.5	15.0	29.2
Silver Prolific	1.8	0.95	247.0	135.0	54.8
Springcrest	1.2	0.77	74.6	48.5	65.0
Sunfre	1.4	0.98	75.0	46.3	69.3
Tebana	1.5	0.92	83.5	53.3	63.8
Villa Ada	1.2	0.68	78.9	43.4	55.0
Villa Adriana	1.6	1.01	95.1	56.6	62.1
Villa Doria	1.9	1.33	99.2	65.1	68.9
Villa Giulia	1.7	1.15	106.0	68.0	67.0
Yumyeong	1.9	1.49	115.0	80.2	80.5

²List of abbreviations used: b/n (Buds/node), fl/n (flowers/node), fl/sl (Flowers/shoot length) and fl/b (flowers/node).

Table 4. Fruit and shoot densities, fruit set and shoot to fruit ratios of 50 peach cultivars at ISF, Rome, Italy in 1991.

	fr/sl	fr/fl	v/sl	s/fr
Adriatica	34.1	63.1	28.1	0.82
Aldrichi	6.1	68.7	24.1	3.95
Allgold	28.6	52.9	39.9	1.39
Armking	26.6	56.4	34.6	1.32
Bajo Aragon	14.7	46.1	24.6	1.67
Balkmi Josaeng	38.5	57.0	33.4	0.87
Br2	1.2	15.6	31.5	26.20
Br3	44.8	66.4	30.5	0.68
Calanda	14.8	43.6	23.4	1.58
Carson	28.0	69.1	34.8	1.24
C. Redhaven	22.5	48.6	39.0	1.73
Convenio	10.9	50.9	35.2	3.23
Elegant Lady	20.2	50.7	24.8	1.23
FA7-4N	44.8	70.3	28.9	0.64
FA8-7N	25.7	59.1	34.3	1.33
Flavorcrest	30.6	80.5	28.0	1.05
Goldcrest	21.8	66.1	19.4	0.89
Goldilocks	32.5	79.4	31.6	0.97
Goodmans Choice	16.6	71.4	24.7	1.48
Grezzano	24.8	54.4	28.8	1.16
Harrow Diamond	20.0	51.9	31.3	1.36
Herrington	27.0	55.7	33.1	1.22
IF7310902	11.9	17.1	24.5	2.05
Independence	25.3	62.8	24.7	1.17
Maria Aurelia	26.3	76.2	37.1	1.41
Maria Serena	19.7	42.7	30.5	1.55
Merrill Pacifica	18.1	42.9	36.0	1.99
Michellini	17.3	57.3	26.6	1.53
Nectaross	21.9	48.4	35.6	1.62
NJC112	30.5	59.9	30.4	0.99
O'Henry	15.4	52.7	25.0	1.36
Perc. Sanguinello	23.6	51.5	32.5	1.38
Pi7620001	32.1	56.5	33.5	1.04
Pillar	14.1	18.4	31.4	1.51
Platicarpa A	38.2	68.1	33.9	0.89
Prof. Black	10.5	40.2	18.4	1.93
Redhaven	21.2	39.8	39.6	1.87
Sangdo	34.5	63.1	27.1	0.78
Seaboksunga	45.6	57.1	33.4	0.74
Sett. Turca	39.7	63.9	41.0	1.03
Shen Shou Mitao	6.4	42.0	30.5	4.70
Silver Prolific	58.2	43.1	61.3	1.05
Springcrest	22.3	45.9	21.3	0.95
Sunfre	26.0	56.1	27.2	1.04
Tebana	31.0	58.1	24.9	1.08
Villa Ada	19.9	45.8	30.7	1.54
Villa Adriana	29.6	52.3	38.2	1.29
Villa Doria	26.9	40.5	33.0	1.22
Villa Giulia	34.4	50.6	37.7	1.09
Yumyeong	41.1	51.6	34.2	0.83

²List of abbreviations: fr/sl (fruits/shoot length), fr/fl (fruit set, fruit to flower ratio), s/sl (shoots/shoot length), s/fr (shoots to fruit ratio).

tion of nodes with 1 bud showed a negative correlation with most variables studied, especially with nodes with 2 ($r = -0.71$), and 3 buds ($r = -0.79$) and b/n ($r = -0.79$), but it did not influence the proportion of buds breaking into flowers ($r = 0.14$ with fl/b) nor fruit set ($r = 0.0$ with fr/fl).

The opposite situation was observed for the proportion of nodes with 3 buds (n3b), which was positively correlated with b/n ($r = 0.89$) and fl/n ($r = 0.62$).

Original bud density (b/m) strongly influenced flower ($r = 0.78$ for f/m), fruit ($r = 0.56$ for fr/m), and shoot ($r = 0.72$ for s/m) densities. Also, the number of buds per node before bud-breaking (bn) was closely related to b/sl ($r = 0.59$) and fl/n ($r = 0.61$).

The proportion of buds breaking into flowers (fl/b) was not influenced by the original bud density ($r = 0.0$, for both b/m and b/n), but it was associated with higher flower densities ($r = 0.77$ for fl/n and $r = 0.62$ for fl/sl).

Flower density (fl/sl) was strongly related to the proportion of buds breaking into flowers ($r = 0.62$) and was related with fruit and shoot densities ($r = 0.78$ and $r = 0.54$ respectively).

Flower bud densities, as expressed by fl/n and fl/sl, were highly correlated ($r = 0.76$), so that either variable could be used in future works to describe cultivars with regular growth types but fl/m is a better indicator to separate standard from shorter internode genotypes.

Fruit density was high for most genotypes (more than 20 fr/sl) and it was associated with high bud and flower densities ($r = 0.56$ and $r = 0.78$, b/sl and fl/sl, respectively), as well as with a high flower budbreaking ratio ($r = 0.59$, fl/b).

Differences among cultivars in the number of vegetative buds breaking along one year old shoots (s/sl) were less than for any other variable included in this study. Cultivars such as 'Springcrest', 'Prof. Black' and 'Gold-

Table 5. Correlation Matrix among variables of one-year-old peach shoots.

	percent of nodes with				b/n	fl/n	b/sl	fl/sl	fl/b	fr/sl	fr/fl	v/sl
	no buds	1 bud	2 buds	3 buds								
1 bud	-0.10											
2 buds	-0.47	-0.71										
3 buds	-0.45	-0.79	0.50									
b/n	-0.61	-0.79	0.69	0.89								
fl/n	-0.41	-0.57	0.51	0.62	0.61							
b/sl	-0.35	-0.51	0.49	0.54	0.60	0.38						
fl/sl	-0.31	-0.41	0.58	0.43	0.47	0.76	0.78					
fl/b	0.00	0.14	0.17	0.00	0.00	0.77	0.00	0.62				
fr/sl	-0.27	-0.42	-0.39	0.43	0.46	0.71	0.56	0.78	0.57			
fr/fl	0.06	0.00	0.00	0.00	0.00	0.00	0.20	0.10	0.07	0.44		
v/sl	-0.30	-0.34	0.26	0.46	0.46	0.30	0.77	0.59	0.00	0.50	0.02	
s/fr	0.09	0.00	0.13	0.10	0.00	-0.44	0.00	-0.38	-0.61	-0.44	0.44	0.00

²List of abbreviations: b/n (buds/node), fl/n (flowers/node), b/sl (buds/shoot length), fl/sl (flowers/shoot length), fl/b (flower to bud ratio), fr/sl (fruit/shoot length), fr/fl (fruit set, fruit to flower ratio), v/sl (vegetative buds breaking along the shoots), s/fr (shoot to fruit ratio).

crest' had the lowest values (less than 22 v/sl), whereas 'Silver Prolific' (dwarf), 'Settembrina Turca,' 'Allgold,' and 'Redhaven' had more than 39 v/sl.

Low fr/sl values could be a consequence of: 1) original low bud densities as in 'Prof. Black,' 'Shen Shou Mitao,' and 'Goodmans Choice,' or 2) a high bud drop (fl/b) ratios lower than 10 or both. This was expressed in some genotypes from warmer regions such as 'Aldrighi,' 'Convenio,' and 'Br2' from Brazil. Those cultivars with very high original bud densities under the warm subtropical winters with low frost risks, are expected to have high fruit sets that will require high fruit thinning and result in higher production costs.

Total budbreak, as expressed by flower and shoot densities (fl/s + s/sl), was high except for those genotypes with low fl/b values. The ratio between vegetative buds and fruits along the one year old shoots (s/fr) ranged between 0.82 for 'Adriatica,' to 26.2 for 'Br2,' but they should probably lie between 1.3 and 2 in order to have a good growth-yield balance as in 'Allgold,' 'Calanda,' 'Michellini,' 'O'Henry,' 'NJC112' and 'Redhaven.'

High bud density should be a desirable trait only after it has been demonstrated that it is associated with bud survival in regions with high frost risks. Otherwise, a more attractive combination medium to low densities (40 to 70 b/sl) with an even distribution along the shoot, and late blooming, which would result in 40 to 60% values for fl/b and fr/fl. This would finally be expressed as fruit densities ranging between 10 and 29 fr/sl which will require less fruit thinning.

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Evaluating Important Fruit Characters in Mango Germplasm

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Abstract

Standardized criteria are needed to select mango (*Mangifera indica* L.) seedlings that merit retention in a varietal improvement program, and to compare selections and cultivars evaluated. Such criteria allow comparisons of seedlings and new or uncommon cultivars with well-known standards. Preferences vary in different regions of the world, and performance of a given cultivar may vary; however, application of this system or clearly defined modifications of it can enhance the interchange of information and plant material worldwide. Traits of importance are shape, size, color, firmness, fiber content, disease resistance, flavor, and productivity. A tabular system for rating these characters was developed and is being used to advantage in a program of mango germplasm evaluation. Occasional defects such as fruit cracking, "jelly-seed," or internal breakdown are noted when necessary in a "Remarks" column. A "Score" column provides space to give an estimate of overall quality; also, a tree slated for discard is designated here by a special sign, "/x/".

The most efficient fruit varietal improvement programs entail an efficient exchange of information and also of germplasm that is evaluated for per-

formance under a wide range of conditions. Such cooperative work involving the U. S. Department of Agriculture and various state and private organizations produced an array of new blueberry and strawberry cultivars superior to those in use earlier (2, 7). Specific criteria vital to a cultivar's success need to be applied to any possible selection to determine its varietal potential. Unless a specific genotype can produce acceptable fruit, resistant to disease and shipping and storage stresses, in sufficient quantities to supply market needs economically, it has no potential as a new cultivar despite other superior attributes it may have. Much time and expense is saved by rigorous use of a rating system that can early pick out the few seedlings in a population that have varietal potential, and compare them realistically with currently important cultivars. Widespread application of such a system can enable one cooperator intelli-

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