Table 2. Nut numerical scores for filbert cultivars in New York, 1972.

Cultivar	Fiber[z]	Kernel[z] size	% fill	% blanks	Kernel appearance	Shell appearance	Numerical unweighted score	Total weighted score
Royal	5	10	6	4	7	6	38	68
DuChilly	10	5	6	4	6	2	33	63
Luisen	9	4	6	4	6	6	35	61
Beeth	10	4	2	5	7	5	33	61
Bixby	10	1	2	8	8	8	37	59
Barcelona	5	7	4	5	8	4	33	57
Italian Red	7	3	7	4	5	8	34	54
Cosford	2	3	7	6	8	7	33	43
Winkler	2	1	1	7	9	1	21	27
Snyder	1	1	1	8	9	2	22	26

[z]Multiplied by 3 for total weighted score.

2). Little consideration was given to a clone which did not score 50 or more in nut characteristics or 100 including tree characteristics unless it possessed an unusual trait.

Cracking quality is of major concern in other nuts, such as black walnuts (6) where the kernels are "bound" by convolutions in the shell wall. Occasional filbert clones contained "bound" kernels, but this was uncommon. Drying or storage prior to cracking can greatly influence kernel weight and yield. Samples from seedlings were found to lose 21-64% of their weight during the curing period.

The proposed numerical scoring system was preferred to a more flexible system (1), based on the range of each characteristic for a given year. With this scoring system, differences in numerical scores within a clone reflect effects of the environment on performance.

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Evaluation and Inheritance of Fruit Color, Size, Scar, Firmness and Plant Vigor in Blueberry[1]

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Abstract. **Repeatability of scoring and inheritance of 5 characters were studied in highbush type blueberry progenies in 2 years. In the repeatability study, fruit size, scar and plant vigor scores were more consistent than fruit firmness and color. Plant vigor scores were high and fruit scar scores were low both years. In the inheritance study, cultivars ranked similarly for each character by either their phenotypic score or general combining ability effects. Mean square variances of general combining ability were larger than specific combining ability for fruit size, firmness, color and plant vigor. Mean square variance of specific combining ability was high for fruit scar. Heritability estimates for blueberry were high for fruit size, moderate for fruit color, low for fruit firmness and scar and lower for plant vigor.**

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Blueberry characters of fruit color, size, scar, firmness and plant vigor have been improved over the past 50 years through breeding, without an understanding of the genetics involved. Inheritance of observed characters in blueberries was first reported in 1939 (2). A consensus from observation is that certain cultivars transmit desirable characters to offspring with a greater frequency than others (1, 3, 4, 5, 6, 7). These data indicate that the characteristics listed are inherited quantitatively. This paper presents the results on the repeatibility, heritability, and combining ability of 5 characters in some tetraploid progenies of blueberry.

Scoring study. Approx 200 1-year-old blueberry seedlings were individually tagged in 1971 to insure positive identification the following year. Fruit size, scar, firmness, color and plant vigor were scored on a 1 to 10 scale with 1 the least desirable. Correlation of 1971 with 1972 data (Fig. 1) indicated that fruit size, scar and plant vigor were not influenced as much as fruit color and firmness by yearly variation. Fruit firmness scores were generally higher and color scores were generally lower in 1971 than in 1972.

Plant vigor scores were high both years. A high score with a high correlation is a desirable feature for it increases breeding predictability for the character. Fruit scar scores were generally low both years indicating a need for new breeding lines with a predominant feature of desirable scar.

Inheritance studies. Phenotypic scores and the diallel cross were used to predict genetic behavior of fruit size, scar, firmness, color and plant vigor. Six cultivars ('Bluehaven' (BH), 'Fla. 3-21', 'Fla. 8-1', 'Fla. 4-65', 'Fla. 6-11' and 'Fla. 4-15') were crossed in all combinations but not reciprocally. 'Bluehaven', a standard highbush type from Michigan, and the Florida cultivars, tetraploids of the highbush type (7), were chosen for their wide range in fruit characters under study.

Flowering of parents for crossing was synchronized by refrigeration to satisfy chilling requirements and retard flowering as needed. Crosses were made in the greenhouse during March 1970. Flowers were emasculated before

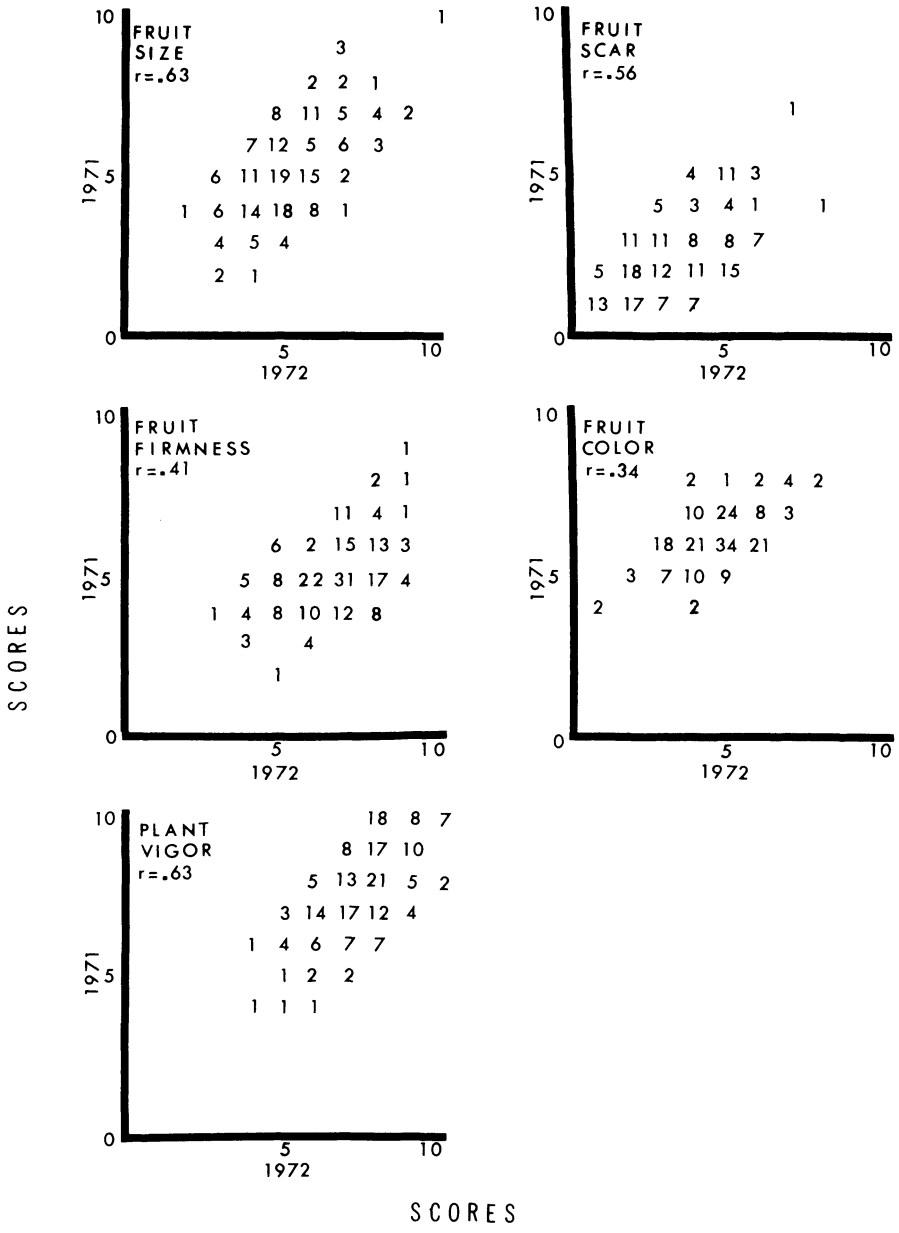

Fig. 1. The relationship of fruit size, scar, firmness, color and plant vigor between 1971 and 1972.

anthesis and pollen was transferred by thumbnail. Ripe fruits were shredded in a food blender and seeds removed by gravity separation, washed and stored in a moist medium in the refrigerator at 4° for 2 months. Then they were removed and germinated in peat moss.

In Jan. 1971, seedlings were transplanted to metal flats filled with peat moss. They were grown in the greenhouse until April and were approx 15 cm tall when transplanted to a nursery previously fumigated with methyl bromide (50 gm/m^2). Plants were set 0.5 x 0.1 m. Plant vigor, fruit color, scar, firmness and size were scored on 50 F_1 plants of each cross in spring 1972. Scoring was on the basis of 1 to 10, with 10 being the most desirable. The resulting data were subjected to Griffing's diallel cross analysis for general combining ability (GCA) and specific combining ability (SCA) (4).

Parental scores and estimates of GCA associated with each parent are presented in Table 1. The 6 cultivars were ranked on the basis of their phenotypic scores for each character. In general, cultivars ranked similarly for each character by either their phenotypic scores or general combinational effects. For example, parents with large fruit contributed genes for larger size than small fruit parents and similarly for fruit scar, firmness, color and plant vigor. Unusually high GCA effects in fruit firmness and color were found in 'Fla. 4-65', indicating it is an excellent genotype for transmitting these characteristics to offspring.

Mean squares of GCA for all characters except fruit scar ranged 2 to 4 times the corresponding mean square for SCA (Table 2), implying that differences within each of these characters were due to additive gene effects. Thus, parents chosen on the basis of fruit size, color, firmness and plant vigor should transmit desirable characters to many of their progeny. The SCA mean square for scar was approx 9 times (8.65) as great as the GCA (0.95). In fact, GCA mean square for scar was the lowest GCA mean square for any character, suggesting a large amount of non-additive gene action for scar. Thus, parents chosen on the basis of small fruit scar may not consistently transmit this character to a high degree in most crosses.

Heritability (h^2) estimates, obtained from regression of progeny means on the mean of its parents, were calculated from $h^2 = b$ (Table 3). Heritability estimates provide varying degrees of predictability in selection of superior offspring on the basis of their phenotypic performance. High heritability estimates of fruit size indicate that progeny fruit size was highly predictable in subsequent generations. This indicates that large-fruited parents should produce progenies with larger mean fruit size than small-fruited parents.

Heritability of fruit color was moderately high signifying that selection of superior seedlings on the basis of their phenotypic performance for this character should be effective in

Table 1. Parental scores and general combining ability (GCA) effects from diallel cross.

Character	Parent	Parent score	GCA effects
Fruit size	Bluehaven	7.0	0.339
	Fla. 6-11	7.0	0.257
	Fla. 3-21	7.0	0.232
	Fla. 4-15	7.0	0.187
	Fla. 4-65	6.0	-0.081
	Fla. 8-11	5.0	-0.933
Fruit scar	Fla. 3-21	9.0	0.353
	Fla. 4-65	8.0	0.318
	Bluehaven	8.0	-0.004
	Fla. 4-15	8.0	-0.024
	Fla. 6-11	8.0	-0.039
	Fla. 8-1	6.0	-0.604
Fruit firmness	Fla. 4-65	9.0	0.787
	Bluehaven	8.0	0.377
	Fla. 6-11	7.0	0.174
	Fla. 4-15	6.0	-0.128
	Fla. 3-21	5.0	-0.268
	Fla. 8-1	5.0	-0.941
Fruit color	Fla. 4-65	9.0	0.699
	Fla. 6-11	8.0	-0.013
	Bluehaven	7.0	-0.023
	Fla. 3-21	7.0	-0.081
	Fla. 8-1	7.0	-0.267
	Fla. 4-15	7.0	-0.306
Plant vigor	Fla. 8-1	10.0	0.406
	Fla. 6-11	9.0	0.346
	Fla. 4-15	8.0	0.151
	Fla. 3-21	8.0	0.091
	Fla. 4-65	6.0	-0.214
	Bluehaven	5.0	-0.799

Table 2. Degrees of freedom and mean squares for general (GCA) and specific (SCA) combining ability.

Variable	df	Mean square: Fruit size	Fruit scar	Fruit firmness	Fruit color	Plant vigor
GCA	5	1.84**	0.95**	2.82**	1.06**	1.55**
SCA	15	0.43**	8.65**	0.83**	0.34**	0.82**
Error	735	0.03	0.06	0.04	0.02	0.33

**Significant at the 1% level.

Table 3. Heritability estimates of fruit size, color, firmness, scar and plant vigor calculated from regression of offspring on mid-parent values.

Character	Mid-parent h^2 estimates
Fruit size	1.23
Fruit Color	0.58
Fruit firmness	0.35
Fruit scar	0.29
Plant vigor	-0.10

consistently but incorrectly scored too high.

improving future generations.

Fruit scar and firmness has low heritability estimates based on regression of progeny on the mid-parent. Genetic gain should also be obtained for these characters, although the rate of gain would not be expected to be as rapid as for traits possessing very high heritabilities.

The heritability estimate of plant vigor was very low, indicating low genetic variance for this character or that the seedling genotypes were

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Effects of Foreign Edible Berries on the Flavor and Texture of Lowbush Blueberry Products[1]

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Abstract. **Taste panels compared the flavor and texture of lowbush blueberry fruits (*Vaccinium angustifolium* Ait.) with combinations of blueberries and foreign edible berries, commonly called chokepears [fruit of purple chokeberry, *Pyrus floribunda* Lindle (syn. *Aronia prunifolia* (Marsh.) Rehder) and black chokeberry, *P. melanocarpa* (Michx) Willd. (syn. *Aronia melanocarpa* Willd.)], in 14 sensory tests. Combinations which were rated as undesirable were: raw, 20 to 10% chokepears; sauce, 14 to 9%; muffins, 67 to 17%. Per cents of chokepears which were undetected were: muffins and tarts, 14 and 12% and pies, 4 and 2%. Masked by the batter and pastry in muffins and tarts, relatively large percentages of chokepears were acceptable to the panelists.**

The widespread invasion of fields of Maine lowbush blueberry by purple and black chokeberry poses a problem to processors to separate berries in order to conform to grade standards. Locally, the fruits from these shrubs are called "chokepears" or "barrenberries" and have a slightly leathery skin and a puckery flavor similar to that of choke cherries, which probably explains the colloquial name.

To blueberry growers, chokepears are considered to be weeds. Trevett and Durgin (2) applied 11 herbicides in an attempt to selectively kill the shrub but all caused injury to the blueberries.

The berries, somewhat similar in size and shape to blueberries, are rake-harvested with them. The raw chokepears are distinguishable from most blueberries, darker in color and red-fleshed. When processed, i.e. canned or frozen, the characteristic light color of the blueberries darkens and the chokepears are difficult to separate during grading.

In the U.S. Department of Agriculture (USDA) standards for frozen (4) and canned (3) blueberries, barrenberries are considered edible foreign berries other than blueberries, and Class A standards allow not more than 5 in 567 g net weight canned berries, 8 for Class B and 10 for Class C (March 20, 1951); frozen: 10, 16, and 20 foreign edible berries in 454 g for the 3 classes respectively (May 7, 1955).

As the sensory influence of these berries in mixtures with blueberries is unknown, we investigated by taste panels the effects of known quantities of chokepears with blueberries on the flavor and texture of the berry combinations: raw, and in sauce, muffins, tarts, and pie.

Panel members in most of the studies were experienced and had demonstrated taste acuity in previous blueberry studies.

The berries were picked in Washington County in the vicinity of Blueberry Hill Farm, Jonesboro, brought to Orono immediately, refrigerated at 4°C, and used within 3-4 days of harvest. Although the long testing period, August 10 to 31, added the influence of advancing maturity and season to the large genetic and environmental variability characteristic of the wild lowbush blueberry, it was deemed that the berries were representative of the Maine crop and that they were comparable within a specific test.

A training session for the panel familiarized the judges with the qualities of the different berries. The test berries (5 to 10) were served in red candle holders. The judges were requested to take all of the served berries into the mouth at one time without looking at them, thus making it unnecessary to mask the lights.

Raw. In 6 tests, one chokepear "diluted" with 4 to 9 blueberries (10 to 20% by number) were judged by 29 to 32 panelists against all-blueberries in paired comparison designs according to Scheffe (1).

Sauce was made to simulate pie filling. The sugared blueberries and chokepears were cooked separately in casseroles at the time-temperature recommended for pie. The berries were served in the red glasses with 2 ml juice. In 3 tests of 3 samples each, panels evaluated all-blueberry against 2 mixed samples (14 to 9% chokepears) in

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