

ceptible varieties within three to five United States, which devastates sus- years after exposure. Morrow bushes are characteristically medium-sized and rather slow-growing after the third year in the field. The bush is broad and round-topped, with several thick canes arising from the base of the crown. Fruit clusters are usually borne upright at the periphery of the bush so that picking is easy. Leaves are subject to Septoria leaf spot. Morrow cuttings usually root readily from

either hardwood or softwood stems.

Morrow appears promising as a cane canker-resistant, very early variety for use in North Carolina and the Southeastern United States to replace Angola. The variety resulted from the cooperative blueberry breeding program of the Department of Horticultural Science, North Carolina Agricultural Experiment Station, and the Small Fruit and Grape Investigations Section of the U. S. Department of Agriculture.

## Differences in Growth, Chemical Content, and Fruit Set Among Four Sports of Delicious Apple

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Previous reports (1, 2, 3) indicated a number of differences between Starking Delicious and a compact mutant of Starking. The mutant had longer fruits with redder skin, greener flesh, and matured later than Starking. It also had shorter internodes, thicker leaves, and fewer lateral branches. Leaves of the mutant contained more nitrogen and calicum, and more chlorophyll than Starking.

These several differences between two sports suggested that other sports of Delicious might also vary in important ways other than fruit color. This report indicates differences found among four sports of Delicious.

In 1963 Delicious sports Starking, Chelan Red, Starkrimson, and Idaho Spur on Malling-Merton 104 rootstock were planted at the Lewis-Brown Horticultural Research Farm at Corvallis, Oregon. During 1966 and 1967 xarious measurements were made and samples collected for mineral analysis. Chemical analysis procedures were done under the direction of Dr. O. C. Compton as previously described (3). Six single-tree replicates per strain were used, with 10 branch-units per tree being measured. Bloom and fruit

set were obtained in 1967 only. Two limb units of about 40 clusters each per tree were tagged before bloom and percentage bloom and fruit set were determined (fruit set is expressed as fruits per 100 blossoming clusters). Cross pollination was provided by heavy flowering Golden Delicious trees one space away from the test trees.

The four mutants of Delicious differed in several growth characteristics (Table 1). Chelan Red was similar to Starking, but had slightly shorter internodes, indicating a tendency toward compact growth habit. Starkrimson and Idaho Spur were similar to each other, and showed the characteristic upright growth habit, thick stems, short shoots and internodes, which distinguish spur mutants from standard varieties.

Starking leaves contained significantly less N than other sports but had similar contents of P, K, Mg, B, Mn, and Zn (Table 2). In this case, Chelan Red was more like the spur types than Starking. As previously reported (3), Starkrimson leaves contained more Ca than did those of Starking. Idaho Spur was similar to

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TABLE 2. Leaf nutrients as related to Delicious apple sports on MM 104 rootstock.

Delicious sport	Percent (dry wt.)					ppm		
	N	P	K	Ca	Mg	B	Mn	Zn
Starking	2.66	.20	1.05	1.00	.352	44	35	34
Chelan Red	2.87	.21	0.94	1.04	.375	39	38	38
Starkrimson	2.83	.21	1.00	1.09	.386	39	33	41
Idaho Spur	2.74	.21	1.06	0.97	.342	42	36	37
L.S.D. (.05 level)	0.09	N.S.	N.S.	0.08	N.S.	N.S.	N.S.	N.S.

TABLE 1. Differences in growth and fruiting among four sports of Delicious apple on MM 104 rootstock.

Delicious strain	Trunk x-sect. area	Tree ht.	Tree spread	Shoot dia.	Shoot length	Nodes per meter	Leaves per meter 2 yr. wood	Fruit set
	cm <sup>2</sup>	feet	feet	cm	cm	no.	no.	per 100 cl.
Starking	58	11.7	9.4	.48	83.8	38.5	234	34
Chelan Red	43	10.1	8.0	.47	82.0	39.7	259	84
Starkrimson	41	10.0	5.6	.51	69.4	42.2	318	55
Idaho Spur	37	9.6	4.8	.50	69.6	41.5	308	106
L.S.D. (.05 level)	8	0.8	1.2	.02	3.7	1.1	22	34

Starking rather than Starkrimson in leaf Ca.

Trunk cross sectional area among the sports was roughly proportional to tree size, although Chelan Red deviated somewhat and ranked more like the spur types than Starking (Table 1). Percentage bloom was similar for all sports (between 54 and 64%), but fruit set differed markedly. Again, the difference in set bore no relationship to fruit color, shape, or spur habit of growth. Fruit shape (length/diameter ratio) was 1.08 for Starking, 1.07 for Chelan Red, 1.08 for Starkrimson and 1.04 for Idaho Spur. However, the fact that Idaho Spur set the heaviest crop and also had the shortest fruits indicates an effect of heavy cropping on shape. We previously showed (2) that heavy cropping trees had shorter fruits than did light crop trees.

The striking differences in fruit set among the four sports indicates the importance of determining that factor in any evaluation of color sports. Also,

differences in fruit shape not related to crop density could be economically important, and therefore should be determined in evaluation of sports. In fact, all of the differences found in leaf morphology, growth habit, mineral nutrition, fruit color and shape, maturity, and fruit set are of potential importance to the grower because they determine both efficiency of production and market potential.

The rather upright, compact tree developed by some mutants lends itself nicely to high density tree-wall plantings. For example, a compact mutant on EM IV or VII stock develops a tree that could be grown at a 12' x 4' spacing. Such a system would have a much greater cropping potential than standard Delicious on EM IX at the same spacing.

Obviously variety and sport testing, to be meaningful, should encompass cropping potential and growth habit along with the usual observations. The many differences found between mutants of a variety indicate that they

should be evaluated as *separate varieties*. The practice of selecting sports solely on the basis of fruit color or growth habit is unsound, in view of these findings.

#### Literature Cited

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## On the Domestication of the Lowbush Blueberry

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The highly flavored lowbush blueberry is a crop that is cultivated by time established methods. "Tradition says that the (blueberry) barrens of Maine were first burned over by the Indians to encourage the growth of blueberries at some remote period long before white settlers came to the valleys of the Narraguagus and Pleasant rivers." Gathering blueberries on these barrens was a public privilege for more than a hundred years after the neighboring seacoast towns were first settled. After more than 150 years, with the exception of systematic pruning by fire and controlling certain insects, cultural practices have changed little. Due to the "wild" nature of natural commercial stands planting, fertilizing, weed control and other cultural practices have been generally unsuccessful or inefficient. The abundance of competing flora has been a major obstacle in attempts to increase yields of lowbush blueberries.

Blueberry fields of Maine and Eastern Canada are comprised of two major species, *Vaccinium angustifolium*, the common lowbush blueberry, a tetraploid; and *Vaccinium myrtilloides*, the sour top blueberry, a diploid. Individual clones of these species are scattered over approximately 100,000 acres of cleared land in Maine resulting in a wide range of morphological variation. In addition, the ex-

treme irregularity of the topography generally deters the development of mechanized practices such as mechanical harvesting.

To overcome many of the difficulties encountered by the lowbush blueberry grower, research at the University of Maine has been directed toward the establishment of new plantations, specifically toward clean cultivation in rows similar to strawberry culture. Many superior selections have been made over the years which make up a nucleus of future varieties. Propagation of lowbush blueberry plants by softwood stem cuttings or rhizome cuttings has proven successful. Up to 99% rooting has been attained with the former method (1). A deterrent in establishing row cultures is the retarded development of rhizomes after transplanting. The subterranean rhizome system is the chief means of plant spread within the row.

Development of vigorous plants with a pre-established rhizome system prior to transplanting is necessary to overcome the lag in rhizome development under field conditions. Vigorous plants can be obtained by maintaining rooted cuttings under relatively high temperatures and long photoperiods (3) as well as an optimum soil environment (2).

Several field trials were established

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