Color Sports of Apples Induced by Radiation[1]

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In an earlier report published in this journal in 1954 (Vol. 9 No. 2), it was shown that the use of X-rays could induce sectorial fruit color changes in apples—changes which because of the market demand for red color were potentially of considerable practical value if they could be obtained as complete sports. Since then, further results of this research (Bishop, 1957, 1958) have indicated that in a small number of cases complete color changes may result. As these are types which may have some commercial value, the sort of changes which can be expected from radiation treatment of somatic tissue is of considerable interest to the fruit breeder.

First of all it should be emphasized that, while not as long a project as growing seedlings from apple crosses and selecting desirable individuals, radiation breeding does require an appreciable length of time. The project at Kentville was started in 1948 and six to eight years were required to identify, isolate, and confirm by successive fruitings the presence of complete color sports. This, in spite of the fact that the numbers of treated scions involved (see Bishop 1956), made it a project of major proportions.

The varieties used included the following: Yellow Bellflower, Cortland, Sandow, Golden Russet, Macoun and Secor, and the total number of treated scions was approximately 13,000. None of the varieties in the experiment have any reported natural color sports. They were chosen because they included several different color types: Yellow (Yellow Bellflower), partly colored (Cortland, Sandow, Secor), russeted (Golden Russet), and dark red (Macoun); and also because red sports would potentially improve their commercial value. Cortland has the additional advantage of coming into fruiting at an early age, thereby providing results more rapidly. The parentage of Yellow Bellflower is unknown. Sandow is a seedling of Northern Spy. Cortland is from a cross between McIntosh and Ben Davis. Golden Russett is of unknown parentage. Macoun is from a cross of McIntosh and Jersey Black, and Secor is a seedling of a cross of Salome and Jonathan.

Radiation treatments were made by exposing dormant scions, cut in two-scion lengths, to either 3-4000r of X-rays or 2-8 hours thermal neutrons. The latter treatments were made in the Brookhaven pile at an average neutron flux of 5.4×10^8 neutrons per cm^2 per sec. Following radiation the scions were framework grafted (Hilton 1946) into grown trees, inserting about 150 scions per tree.

The first fruits produced in the project showed a number of color changes, but of a sectorial nature (Bishop 1954). These were in the direction of both more red color and less red color, and involved sectors varying from narrow stripes to one-quarter or one-half the apple. Many of the larger sectors were difficult to interpret because of color intensity variations due to location in the tree. However, it now seems probable that the

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majority represented reductions in color rather than increases.

The first unmistakable dark red sports were observed in thermal neutron treated Cortland material, and were found both as sectorial chimeras and complete sports. In these, the shade of color (See Figure 1) was sufficiently different that the fruits could be spotted from a distance and appeared distinct from the color of the apples on the remainder of the tree.

Complete sports also occurred with two other varieties, Golden Russet and Sandow. In the case of the Golden Russet fruits, there was both a decrease in russeting, although not a complete elimination, and an increase in red color. A number of degrees of expression were found in the Russet mutants, and in some instances the change involved only the russeting of the fruit, resulting in a green fruit relatively free of russeting.

A rather similar variation in russeting has been noted previously (Gardner *et al.* 1948) in Golden Russet fruits from individual spurs, indicating that probably some of the variation observed was natural and not due to the radiation.

The Sandow sport occurred twice and was a "reverse" mutation, showing a decrease in color and an increase in russeting. This mutation also seemed to be accompanied by a slight decrease in the size of the fruit.

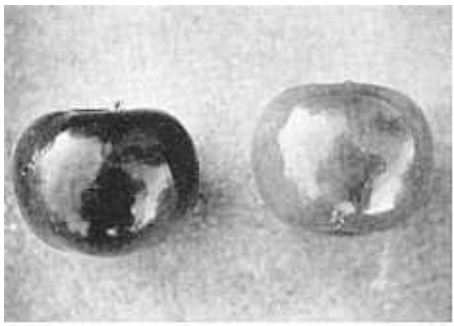

Figure 1. **A radiation-induced complete dark red sport (left) of Cortland in comparison with the original Cortland variety (right).**

Several interesting additional observations were made which have not yet been fully explained. One was the fact that there seemed to be an association between shoot bifurcations and the occurrence of complete sports. In such cases one-half of the bifurcated shoot was mutated, while the other half was normal. The inference from these observations was that the cytological event which resulted in the shoot bifurcation was also in some cases causing or associated with the mutation.

The second apparent anomaly was that sectorial chimeras, although quite frequent, occurred only in the variety Cortland. None of the other varieties showed any sectorials, even though they are known to occur naturally in at least one, Golden Russet.

It might be expected that other characters besides color and russeting would be affected by radiation. The only ones yet noted have been fruit size and shape. A number of instances of small distorted fruits occuring on individual branches have been observed. These were very similar to the natural and induced sports of this type recently reported by Einset and Pratt (1959).

Attempts were made to detect branches resistant to apple scab by examination of fruit and leaves following seasons in which no fungicides were applied; but none was located. Pollination studies in a search for self-fertile sports also did not reveal any mutations from the normal self-sterile condition.

The only sports found which appear to have any possible commercial value are the dark red sports of Cortland. These have been propagated, but have

not yet reached fruiting for a careful comparison with the standard type. Observations of the fruits from the original branches would suggest that while they have a darker shade of color they may not have a higher percentage color. However, in areas where Cortland fails to develop an intense color these radiation-induced sports may prove to be of definite value. Limited quantities of propagation stock are available from the Kentville Research Station.

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Italian Apple Varieties

Italy has until recently been exporting the apple varieties Abbondanza from the Ferrara district, and Tyrolean varieties from the Balzano district. However, in the past few years, Italian growers have been planting a lot of Starking and other Red Delicious sports for the export market.

A New Clone of Loganberry

A sub-clone of the East Malling 1932 clonal loganberry is being distributed by the Nuclear Stock Association of England for commercial use. This sub-clone, LY-59, yielded a first crop of 4.2 tons per acre in 1959 in a field test at Long Ashton, where it was being perpetuated.

Color or Eating Quality?

Fifty-nine percent of a large sample of housewives from all parts of the nation but New England, indicated juiciness, and 49%—sweetness, as the characteristic they most desired in apples. This was announced in a preliminary report by A. J. Wood Co., Phila., in connection with a survey they have been conducting among consumers for the Washington State Apple Commission. The same housewives gave equal preference to Delicious apples that have been colored artificially to provide fruit with 50%, 70% and 90% color.