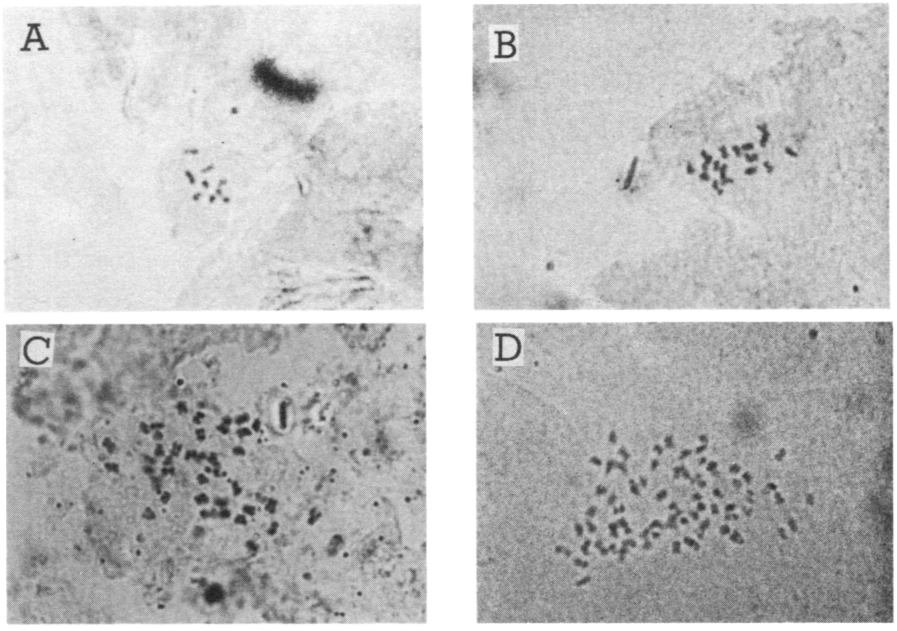

Fig. 1. Mitotic chromosomes in PFP treated root tip cells of grape seedlings from 'Neo Muscat', 2n = 38. A. Aneuploid cell with 9 chromosomes. B. Haploid cell with 19 chromosomes. C. Normal diploid cell with 38 chromosomes. D. Tetraploid cell with 76 chromosomes.

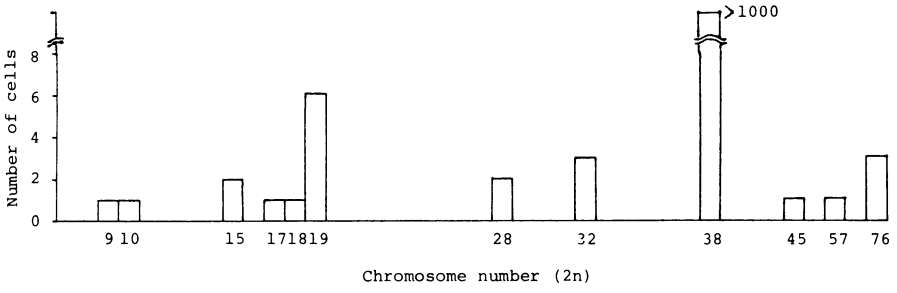

Fig. 2. Variation and frequency of chromosome number in root tip cells of grape seedlings of 'Neo Muscat' (2n = 38) treated with PFP. Normal mitotic figures with 38 chromosomes were counted in more than 1000 cells.

the chromosome number was reduced (Fig. 1). The proportion of roots which contained haploid or aneuploid cells did not show a significant correlation with PFP concentration and ranged from 9.5 to 20.0% (Table 1).

In variant cells of grape seedlings, haploid cells were the most frequent, but the chromosome number ranged from 9 to 76 (Fig. 2). Haploid and aneuploid cells were sometimes observed in the same root. All such cells were observed among normal cells, and their frequency was less than 1% of that of diploid cells.

Although fully haploid grape seedlings were not observed, we have confirmed that PFP induced chromosome variation in root cells including haploidy and aneuploidy.

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Influence of Fertilizer and Lime Rates on Nutrient Concentration in Highbush Blueberry Fruit[1]

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Additional index words. Vaccinium corymbosum, nitrogen, phosphorus, potassium, calcium, magnesium, micronutrients

Abstract. **Concentrations of N, P, K, Ca, Mg, Mn, Fe, Zn and Cu in blueberry fruit (*Vaccinium corymbosum* L. cv. Wolcott) as influenced by 3 rates of N, P, and K and 2 rates of lime were determined for 2-4 years. Concentration varied among years, but the variation was much less for N, P, K, and Ca than for Mg and the micronutrients. Application of N, P, or K increased the concentration of the element applied. Application of lime did not influence elemental concentrations. Increasing N rates decreased fruit Ca, and P decreased Mn concentrations each year.**

The elemental concentrations, especially of cations, in blueberry foliage is usually much lower than those in foliage of other fruit crops (4). Data on the elemental concentration of blueberry fruit are limited and there is unexplained variation among some reported values. This is particularly evident when elemental concentrations of highbush blueberries grown in Michigan (1), North Carolina (2), and Nova Scotia (3) are compared. In general, values for N, P, and K were similar in all reports, but Ca and Mg concentrations varied with geographical location. Bishop et al., (3) observed that as N fertilization increased, concentrations of N and K in the fruit increased, Ca decreased and P and Mg were not affected. Ballinger and Kushman (2) reported a similar effect of N on N and Ca, but also reported that as N supply increased, concentration of P and Mg increased and K decreased. Data regarding Fe, Mg, Zn, and Cu concentrations are sparse (1, 7) while data relative to effects of fertilization on micronutrients are lacking.

A description of treatments, experimental deisgn, field and laboratory procedures and effect of treatments during the years of establishment (6) and on fruit yield and foliar elemental concentrations (5) has been reported. Treatments for 1968-72 (in kg/ha) were N (34, 84, 168), P (0, 25, 50), and K (0, 47, 94) applied annually in factorial combination with 2 lime rates (0 or 2000) applied in 1965. The 100-berry samples taken from the second harvest in 1968, 1969, 1971, and 1972 were

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frozen until chemically analyzed. All elements were determined 4 years except that Mg was determined in 3 and N in 2 years. N determination was by Kjeldahl using a 20 g sample. Preparation of fruit for all other analysis during the first 2 years was accomplished by macerating a 20 g sample in a Omnimixer and drying at 85°C for 24 hr followed by ashing overnight at 470°C. In 1971 and 1972 berries were crushed, dried at 85° for 24 hr and ashed at 470° overnight. After ashing and cooling, distilled H_2O was added to wet the ash followed by 2 ml of concentrated HCl, the sample was heated until dry, then 2 ml of H_2O and 2 ml of contrated HCl added to the crucible, complete dissolution of the sample obtained, and then brought to a 50 ml volume with distilled H_2O. Atomic absorption spectorphotometry was utilized for determination of Ca, Mg, Fe, Mn, Zn, and Cu. P was determined by a vanadate molybdate procedure and K by flame emission spectroscopy.

Lime application did not influence fruit elemental concentration in any year. Thus, these data are not reported.

Variation in fruit elemental concentration of N, P, K, and Ca among years was rather low (Table 1). However, wide variation among years occurred for Mg and the micronutrients. Fruit concentration of N, P, Ca, and Mg, but not K, varied in a pattern similar to foliar concentration previously reported (5). The marked increase of Mg and decrease of Mn with time was also evident in the foliage.

Fertilization with K or P was reflected in increased concentration of those elements in the fruit (Fig. 1). N was determined only in 1968 and 1972 but N in the fruit increased linearly with N rate both years (data no shown). The only continuously significant influence upon elements not applied was the decreased fruit Ca (Fig. 1C) resulting from N application and decreased Mn (Fig. 1D) resulting from P application. In addition, K application decreased Mg in the fruit in 1971 and tended to decrease it in the other 2 years.

In most years, increasing P fertilization from 0 to 25 kg/ha resulted in a much greater increase than obtained from increasing P from 25 to 50 kg/ha. However, in each year the first increment of K resulted in a larger increase of fruit K compared to the increase obtained with the second increment of K. In 2 years, the final increment of K did not significantly increase fruit K above the level obtained with the first increment. When K was not applied, concentration of K in the fruit, especially the last 2 years, was lower than reported values (1, 2, 3, 7).

Application of K decreased fruit Mg only in 1971, but decreased foliar Ca and Mg most years during this study. Application of N resulted in decreases in Ca concentration (Fig. 1C) each year. The high concentration of Mn reported (8) was not evident in this study and application of P resulted in decreased fruit Mn each year (Fig. 1D).

Variation in concentration of Mg and the micronutrients associated with years was much greater than the effect of treatments (Table 1, Fig. 1). In comparison of values in this study with the other values reported for highbush, there appears to be good agreement for N, P and K (1, 2, 3). However, fruit K was lower than values of rabbiteye blueberries in Geogia (7). Levels of Ca are in agreement with 2 reports (3, 7) but much lower than reported from Michigan (1) and North Carolina (2). Results of this study indicate values similar to values in the literature for Mg, Mn, Fe, Cu, and Zn, with the exception of higher values for Zn in Michigan (1) and higher values for Fe in Georgia (7).

This study shows clearly that fruit concentration of N, P, and K was increased by fertilization with those elements. However, application of 2000 kg/ha of dolomite lime or 700 kg of concentrated superphosphate containing about 100 kg of Ca failed to increase fruit Ca concentration.

Table 1. Annual variation in the elemental concentration of 'Wolcott' highbush blueberry fruit in North Carolina (each value represents mean of 108 samples).

	Fruit elemental level (ppm fresh wt)								
Year	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
1958	988	101	684	55	40	3.0	3.3	1.04	0.76
1969		95	720	60	47	5.3	2.3	1.18	0.80
1971		93	706	57	55	3.5	2.1	1.12	0.68
1972	1045	113	695	59		3.1	1.9	1.44	0.61
LSD 5%	81	5	16	3	4	0.3	0.3	0.12	0.05

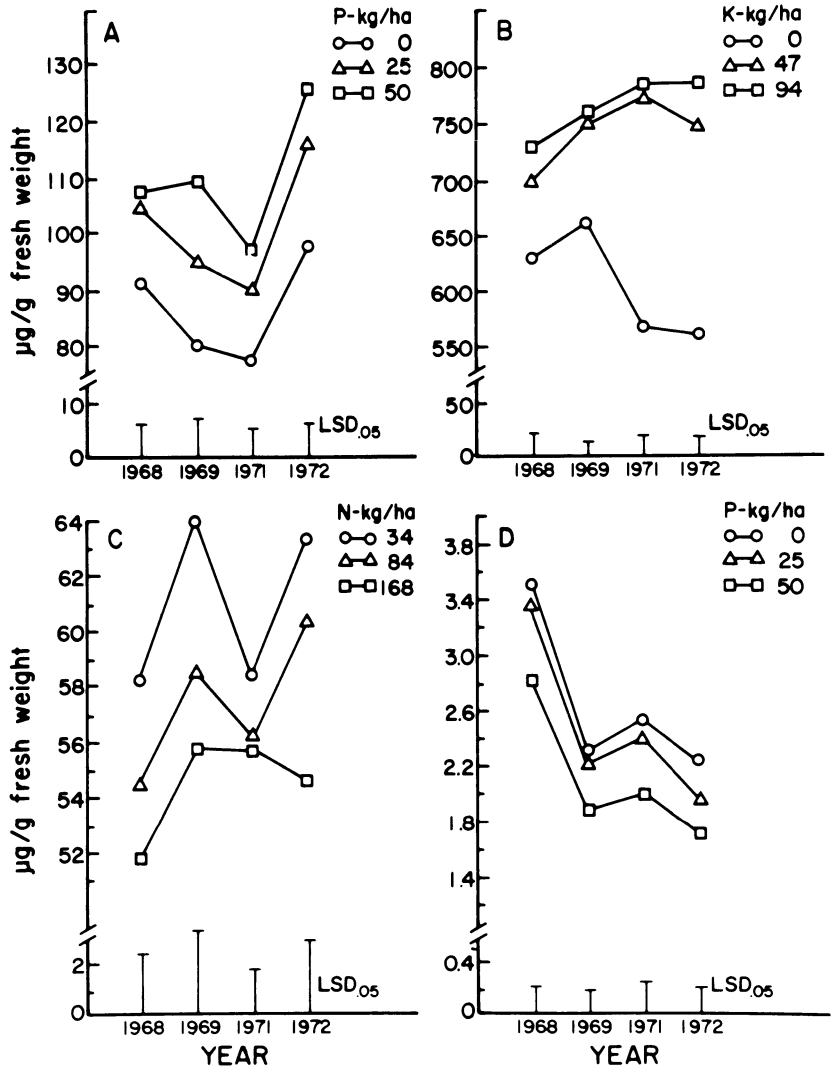

Fig. 1. Influence of application of (A) P upon P, (B) K upon K, (C) N upon Ca, and (D) P upon Mn concentration in blueberry fruit.

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Separation and Processing Effects on Aromatic Components of Saskatoon Berries (*Amelanchier alnifolia* Nutt.)[1]

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Additional index words. gas chromatography

Abstract. **Aroma essences of reproducible composition were separated from saskatoon berries by concentration of the headspace. Gas chromatography revealed 12 components in the aroma essences. The quantitative composition of the essences differed significantly among fresh berries, juice and jelly, and among fruit from 2 locations.**

Saskatoon, a rosaceous fruit, is found throughout the Canadian Prairies, southern Yukon and Northwest Territories, and the northern prairie states of the United States. Other species of *Amelanchier* are found elsewhere in North America and in parts of Europe and Asia where they are better known as serviceberry, shadbush, or juneberry (1).

Saskatoons have been used by the American Indians for centuries in pemmican, and were a major source of fruit for the early settlers of the North American prairies. The fruit is usually purple and ranges in diameter from 0.6 to 1.0 cm in the wild, and up to 1.6 cm under cultivation. Within the past decade considerable interest has been shown in bringing this fruit under cultivation, and in Alberta several orchards of saskatoons have come into production. This development, together with increased research activities in the areas of propagation, harvesting, plant development and processing (1, 2, 3) prompted the initiation of an investigation aimed at the identification of the major volatile components of saskatoons. This was thought important in the light of observations made when processing this fruit into jelly and juice that significant amounts of saskatoon flavor were lost during even mild heat treatment. Literature concerned with volatiles of saskatoons is non-existent and that for non-volatile constituents of the fruit is limited. Tuba et al., (6) indicated that saskatoons might be a useful source of Vitamin C. These workers, using the classical 2,6-dichlorophenolindophenol titration for Vitamin C estimation, reported 5-38 mg/100 g of ascorbic acid in fresh fruit. The method they used has limitations since saskatoons contain purple coloring pigments which obscure the endpoint of the titration. Subsequently, Panther & Wolfe (5) reported that saskatoons had a negligible ascorbic acid content and that ascorbic acid added to saskatoon juice was rapidly degraded. The predominant acid of ripening saskatoons is malic, while the major sugars are fructose and glucose (7).

Firm-ripe 'Smoky' saskatoon berries hand-harvested on August 1, 1978, were used for this study. Fruit was cleaned and frozen immediately in 0.5 kg lots and stored at -29°C for 3 weeks before the volatile analyses were initiated. The thawed fruit had the following characteristics: 21.5% total solids, 15.9% soluble solids, and 4.2 pH.

The juice used for the analyses and for the preparation of the jelly was extracted using an enzyme-assisted process (2) in which 0.8 parts of 0.5% Spark-L (Miles Laboratory, Rexdale, Ontario) solution to 1 part of fruit were mixed before heating for 30 min at 60°C, screening, pressing and filtering. This process produced a juice with a mild but distinctive flavor which was highly suitable for making jelly.

Jelly was made from juice, extracted as described above, using a 11.4 liter electric kettle (Alloy and Steel Fabricators Ltd., Scarborough, Ontairo) for the boiling operation, and a refractometer (Bausch and Lomb, Rochester, New York) for determining the finishing point. White sugar, citric acid and rapid set, 150 grade pectin (Bowes Co. Ltd., Montreal, Quebec) were used in the formulation. Citric acid and commercial pectin were used to adjust the pH to 3.2, and to reinforce the pectin content of the juices, respectively. The amount of sugar used in the formula was 49.0% of the total weight. The soluble solids content of the jelly, as determined with a refractometer, was 65%. The texture was smooth and firm, and the color was that of the fruit.

The volatile compounds of thawed saskatoons and saskatoon products were separated by a gas chromatographic (GC) procedure developed previously for dehydrated onion (3). Fifty grams of thawed, whole saskatoons, or an equivalent amount of processed product were mixed with 50 ml of pre-boiled distilled water in a 300 cm^3 stainless steel jar, fitted with a blending blade and a 2-port screw-cap connected to a nitrogen supply and to a 6-way, heated-type gas sampling valve (Varian Aerograph, Walnut Creek, California). The gas valve was on the exterior of a Hewlett-Packard Model 5710A gas chromatograph, connected to the gas chromatograph column and the injector. It was fitted with a 16 × 0.32 cm O.D. stainless steel trap containing approximately 12 cm of a porous polymer, Tenax-GC (Enka, The Netherlands) between glass wool plugs. The fruit-water mixture (inside the sealed jar) was blended for 30 sec, placed in a water bath at 40°C and swept with purified nitrogen, at 50 mg/min, to the Tenax-GC trap. During sampling, the trap was held near 0°, by placing a block of ice in an aluminum dish on its surface. After 15 min, the trap containing the saskatoon volatiles was backflushed by redirecting the GC nitrogen carrier gas through the trap and into the column. Immediately after activating the gas valve (injection) the Tenax trap was heated to 225° and kept at this temperature for the entire length of the gas chromatographic program, i.e., 1.0 hr. The heating of the trap was accomplished by replacing the block of ice with a block of brass held at 225° by means of a heating tape.

Volatiles were separated using 2.44 m × 3.175 mm O.D. dual stainless steel columns packed with Chromosorb 101, 80/100 mesh. The oven was held at 50°C for 4 min after injection, then programmed at 4°/min to 190° with a final period of 24 min at 190°. Gas

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