Relationship between Core Size, Specific Gravity, and Soluble Solids in Carrots[1]

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Abstract. **The r values between core/whole root diameter ratio and soluble solids of roots of carrot (*Daucus carota* L.) varied from 0.385 to – 0.473 depending upon cultivar and location. The r value for the cultivar means between the same variables was –0.434. Selection for core size has little potential as an indirect method for raising soluble solids. A correlation of 0.621 was found between specific gravity and soluble solids in 'Nantes Strong Top'.**

The report (3) that carrot roots with high phloem/xylem ratios have high total sugar implies that the breeder can exert selection pressure for high total sugar by selecting roots with low ratios of core/whole root diam. However, the effectiveness of using small cores as an indicator of high soluble solids depends on the degree of association between the ratio of core/whole root diam and soluble solids.[3] The primary objective of my research was to estimate the correlation between these 2 variables.

Werner (3) also reported that the specific gravity of carrot roots varies directly with total sugar. However, it would be useful to measure this association more thoroughly. A study was undertaken to estimate the correlation between specific gravity and soluble solids in 'Nantes Strong Top'.

Samples were taken from 11 cultivars grown in Leon fine sand at Gainesville, and 13 cultivars grown in organic soil at Zellwood in Central Florida. All were planted in Oct. and harvested in Feb.

Two cuts were made on each of the 30 roots sampled for each cultivar. The lower ¼ of the root was discarded. Then a 1 cm section was taken for subsequent refractive index readings. The cross-section of the remaining root was measured for both the core and whole root diam.[4]

The specific gravity samples were taken from the upper 9-10 cm of the roots just below the crown. Twenty-seven roots of 'Nantes Strong Top' were weighed in air and then in water to the nearest mg for specific gravity calculation.

The samples for soluble solids determination were frozen in polyethylene bags at -27°C and subsequently were thawed and brought to room temp for refractive index measurements of the juice.

An r value relating core size and soluble solids was calculated for each cultivar (Table 1); only 4 were significant. The distribution of the r values was rather wide and lacked a distinct mode, with none of them large enough to have practical predictive value in breeding. One cannot select core size and consistently affect soluble solids.

The r value 0.385 for 'Nz 251' was rather inconsistent with the other values and deserves comment (Table 1). 'Nz 251' was a selection from Asgrow 'Hicolor 9' for Nantes-type shape, and the best Nantes roots had smaller cores and lower soluble solids. Perhaps the low soluble solids of the best Nantes roots may be explained by their weak tops which did not compete well in the dense foliage of 'Hicolor 9'.

The r value between the cultivar means for core/whole root diam ratio and soluble solids was significant (r = –0.434) at the 5% level. This means that large cores were slightly associated with low soluble solids, when one considers the distribution of the means of all the cultivars sampled. The inverse relationship between core size and soluble solids was in agreement with previous work (3).

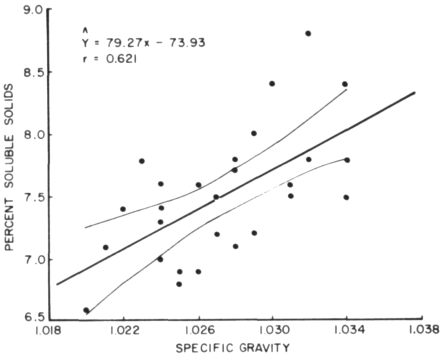

Fig. 1. Regression of soluble solids on specific gravity in individual roots of 'Nantes Strong Top' (Ferry Morse).

The r value between specific gravity and soluble solids in 'Nantes Strong Top' was significant (r = 0.621) at the 5% level (Fig. 1). Although only one cultivar was measured, the potential value of differential specific gravity as a rough screening technique to select carrots with high soluble solids is clear. Further work is needed to determine whether the high r value seen in 'Nantes Strong Top' holds for genetically diverse cultivars, and if a practical technique for screening by differential specific gravity can be devised.

Literature Cited

1. Carlton, B. C., and C. E. Peterson. 1963. Breeding carrots for sugar and dry matter content. *Proc. Amer. Soc. Hort. Sci.* 82:332-340.
2. Nakdimon, U., A. F. Kust, and W. H. Gabelman. 1972. A technique for studying quantitatively the variation in size and shape of carrot roots. *HortScience* 7:273-276.
3. Werner, H. O. 1941. Dry matter, sugar, and carotene content of morphological parts of the carrot through the growing and storage season. *Proc. Amer. Soc. Hort. Sci.* 38:267-272.

Table 1. Soluble solids, core/whole root diam ratio, and correlation coefficient between soluble solids and core/whole root diam ratio of 15 carrot cultivars.

Cultivar	Location[z]	Soluble solids	Core/whole root diam ratio	r
Kinko 6	Z	6.88	.378	.108
Kinko 8	Z	7.13	.388	–.110
Nz 251	Z	7.09	.332	.385*
Nantes Strong Top	Z	7.84	.459	–.284
Nantes Strong Top	G	7.95	.405	–.293
Waltham Hicolor	Z	8.12	.350	–.029
Waltham Hicolor	G	8.55	.304	.062
Pioneer F_1	Z	8.70	.346	.021
Pioneer F_1	G	8.13	.346	.135
Gold Pak	G	8.75	.339	.036
Hipak Elite F_1	Z	8.24	.381	.104
Hicolor 9	Z	6.81	.367	–.193
Hicolor 9	G	8.72	.303	.125
Caravella F_1	Z	6.83	.503	–.385*
Caravella F_1	G	7.53	.429	–.136
Spartan Bonus F_1	Z	7.96	.499	–.064
Spartan Bonus F_1	G	9.30	.399	–.033
Carousel F_1	Z	7.21	.488	–.213
Carousel F_1	G	8.31	.405	–.261
Danvers 126	Z	7.26	.539	–.160
Danvers 126	G	8.22	.482	–.386*
Scarlet Nantes	Z	6.35	.454	–.473*
Scarlet Nantes	G	7.77	.394	–.008
Imperator Extra Long	Z	7.53	.454	–.165
Imperator Extra Long	G	8.94	.361	–.160

[z]Z = Zellwood (organic soil); G = gainesville (Leon fine sand).
*Correlation significant at 5% level.

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[3]The terms "total sugar" and "soluble solids" can be used almost interchangeably when referring to carrots because correlations of 0.791 to 0.844 have been reported between these factors (1).

[4]After the completion of this experiment an ingeniously direct and rapid method of measuring the core/whole root ratio was reported (2). The method is based on the geometric properties of a specific triangle and a simple apparatus.