High Carotene Mass Carrot Population

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Carotenes from vegetables and fruits are vitamin A precursors that contribute about half of the vitamin A in the U.S. diet (3) and two-thirds of the world diet (5). Carrots typically contain 65 to 90 ppm carotenes (1) and are estimated to be the major source of carotene for U.S. consumers (3). Few provitamin A sources surpass the carotene content of typical carrots, although red palm oil can contain >825 ppm carotenes (2). Genetic selection for higher carotene levels in carrots could increase the dietary consumption of carotene and consequently vitamin A. A high carotene mass carrot population was developed for use in breeding, genetic, and biochemical studies of carrot (Fig. 1).

Origin

High Carotene Mass population (HCM) was derived from a cross of [('Kokubu' x

B2158)F₄] \times [(B3079 \times 'Imperial Long Scarlet')F₃], made in 1974. Both parents in this hybrid were developed to combine the Alternaria leaf blight resistance of the Japanese cultivars Kokubu (PI 261648) and Imperial Long Scarlet, with the desirable root shape and color for U.S. production found in B2158 and B3079. B2158 was derived from an openpollinated synthetic fresh-market carrot population of diverse origin. B3079 was developed from the cross B8549 \times B5931, two fresh-market carrot inbreds.

The potential to develop a high-carotene population from this cross was first noted in the F₂ generation in 1977, which resulted from a mass pollination of five F_1 plants. Although the four parents contributing to HCM contained between 110 and 185 ppm total carotene, the average carotene content of the F₂ generation was 203 to 233 ppm, depending on growing location. Since the F₂ generation, mass selection has been conducted for total carotene content. The top 10% to 20% of the plants that were evaluated for root carotene content were allowed to intermate in each generation. An average gain of 24 ppm in total carotene content was observed for each of 11 cycles of selection.

Description

The average carotene content of HCM in the F_2M_{11} generation is 460 to 499 ppm, depending on growing location. This is more than twice the content of the original F_2 . Among higher plants, this is the secondhighest carotene content reported, surpassed only by red palm oil. β -carotene accounts for 45% to 65% of the HCM carotene content, α -carotene 20% to 40%, zeta-carotene 5% to 10%, and other carotenes up to 5%, depending on growing conditions (4). The



Fig. 1. Roots and root slices of High Carotene Mass carrot.

carotene content of hybrids of HCM with various carrot inbreds typically approximates the average of carotene content of both parents. HCM restores fertility in hybrid combination with cytosteriles.

Availability

Inquiry regarding seed availability for HCM should be directed to P.W.S.

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