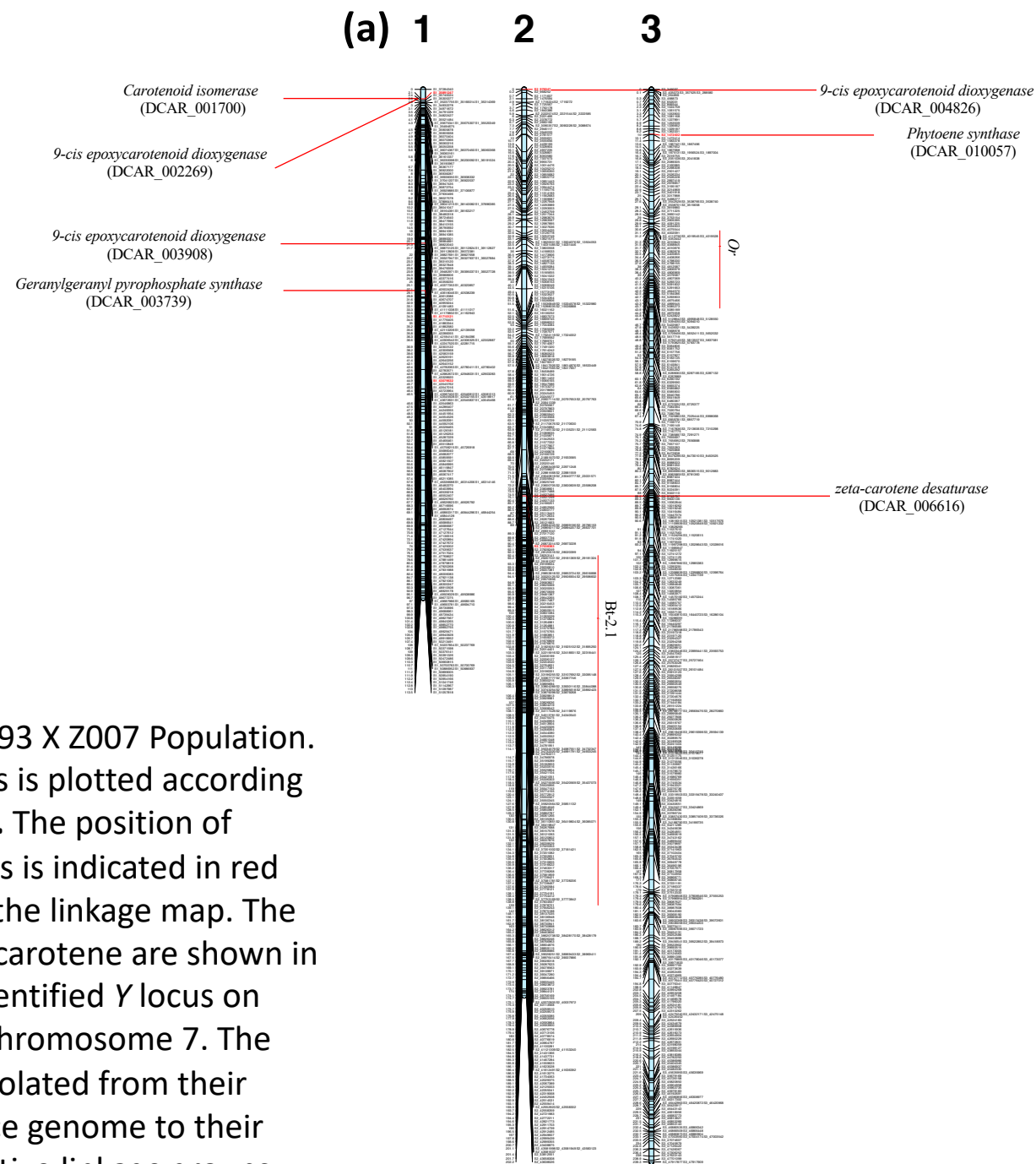


**Fig. S1** Phenotypic means for carotenoids across each of the three environments tested. **(a)**  $\beta$ -carotene, **(b)**  $\alpha$ -carotene, **(c)** lutein, **(d)** phytoene, **(e)**  $\zeta$ -carotene, **(f)** total carotenoids, **(g)** the ratio of  $\beta$ -carotene to total carotenoids. Values are in  $\mu\text{g/g DW}$  except for  $\beta$ :total. CA2018: California 2018, CA2019: California 2019, and WIGH2018: Wisconsin Greenhouse 2018



**Fig. S2** Linkage groups for the B493 X Z007 Population. The distribution of 1,668 markers is plotted according to their respective linkage group. The position of known carotenoid pathway genes is indicated in red relative to the closest marker in the linkage map. The locations of QTL identified for  $\beta$ -carotene are shown in red, along with the previously identified  $Y$  locus on chromosome 5 and  $Y_2$  locus on chromosome 7. The positions of  $Y$  and  $Y_2$  were interpolated from their physical positions in the reference genome to their genetic positions on their respective linkage groups.

(b) 4 5 6

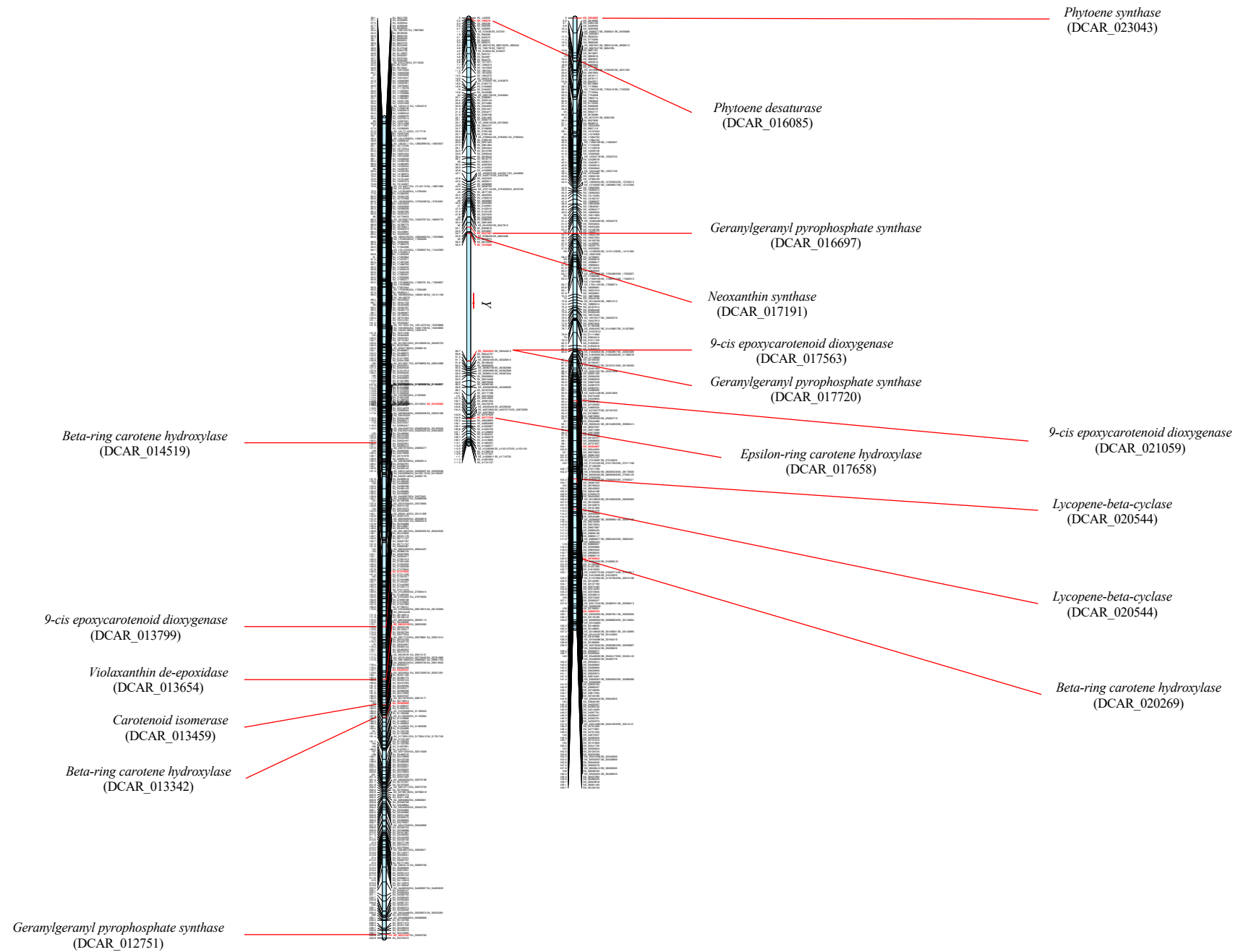


Fig. S2 continued

(c) 7

8

9

15-cis-zeta-carotene isomerase  
(DCAR\_023800)

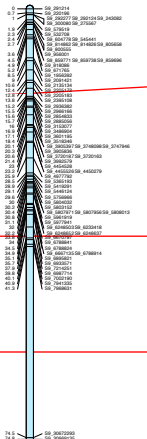
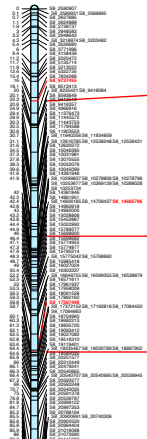
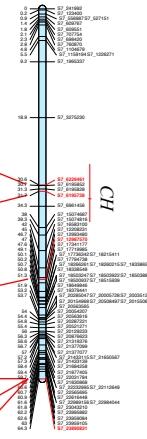
Beta-ring carotene hydroxylase  
(DCAR\_023843)

Phytoene synthase  
(DCAR\_024333)

zeta-carotene desaturase  
(DCAR\_025321)

Zeaxanthin epoxidase  
(DCAR\_025735)

Neoxanthin synthase  
(DCAR\_025914)



Lycopene epsilon-cyclase  
(DCAR\_028276)

Geranylgeranyl pyrophosphate synthase  
(DCAR\_028137)

9-cis epoxycarotenoid dioxygenase  
(DCAR\_027908)

9-cis epoxycarotenoid dioxygenase  
(DCAR\_027908)

Geranylgeranyl pyrophosphate synthase  
(DCAR\_027908)

Fig. S2 continued