MARKERS ASSOCIATED WITH CAROTENOIDS CONTENT IN VIR *BRASSICA RAPA* L. COLLECTION

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The VIR world wide collection contains more than 51,600 accessions of vegetable and cucurbit crops from 98 countries, including 7303 accessions of vegetable *brassicas* received by VIR since 1923. The uniqueness of the VIR *Brassicaceae* family crops collections reaches 50%. The collection includes accessions of various status: landraces, old and advanced cultivars, inbred and double haploid lines, hybrid populations.

Brassica rapa L. is a very diverse species with the longest cultivation history, and encompasses leafy and rooted vegetables, and oilseeds. The leafy vegetables include heading Chinese cabbage, pak choi, tatsoi, wutacai, mizuna, komatsuna, and neep greens; the turnips include vegetable and fodder types. In *B. rapa* leafy crops the highest content of carotenoids and phenolic compounds among other *brassicas* has been determined. Carotenes, including β -carotene, are the important components of vegetable products quality. Antioxidant β -carotene serves a precursor of vitamin A (retinol), has immune stimulating and adaptogenic effects. Association mapping in plants uses linkage disequilibrium (LD) that presents in natural and breeding populations including collections of plant genetic resources in genebank. Using this tool, the genetic diversity expressed as allelic polymorphism can be related to the observed phenotypic valuable characters.

40 *B. rapa* accessions from the VIR collection encompassing a wide range of carotenoids content types different geographical origin were used in this study. The plants were grown in the field in VIR Pushkin Branch (St-Petersburg). Biochemical analysis of the content of carotenoids, carotenes and β -carotene was conducted by standard methods. For genotyping of accessions and association mapping two *or*-linked SSR markers BRMS-007 (R5, 102.3 cM) and BRMS-051 (R9, 58.4 cM) were applied. These markers were used for QTL analysis of *B. rapa* mapping populations DH30 and DH38; in our previous studies were found that they connect with content of carotenoids. For association mapping the software Tassel v. 4.0 was used.

The biochemical analysis of the genotypes revealed large variations of carotenoids content between 4.73% and 36.51 mg/100 g (the highest content in par choi Choo F1), carotenes from 1.29 to 16.08 mg/100 g (the highest content in leafy turnip Red Komatsuna), β -carotene from 0.86 to 6.68 mg/100 g (the highest content in Choo F1, tatsoi Misome). Association mapping using GLM and MLM models identified significant marker-trait associations ($p < 0.05$) for contents of biochemical compounds. We identified 3 alleles controlling content of carotenoids, carotenes and β -carotene. Allele 270 bp (BRMS-51) controlling carotenoids (avg. marker presence 12.76, marker absence 18.32 mg/100 g; $p = 0.003$), carotenes (avg. presence 3.21, absence 4.91 mg/100 g; $p = 0.005$), β -carotene (avg. presence 2.28, absence 3.39 mg/100 g; $p = 0.007$) content was observed. Allele 158 bp (BRMS-007) controlling carotenoids (avg. marker press. 12.77, abs. 18.68 mg/100 g; $p = 0.013$), carotenes (avg. press. 2.80, abs. 5.00; $p = 0.006$), β -carotene (avg. press. 2.41, abs. 3.39; $p = 0.032$) content was found. Allele 135 bp (BRMS-007) controls content of carotenoids (avg. press. 20.58, abs. 12.84; $p = 0.017$), carotenes (avg. press. 5.31, abs. 3.47; $p = 0.027$), β -carotene (avg. press. 3.69, abs. 2.42; $p = 0.025$) content.

In the present study, we performed the results of association mapping and identified SSR markers associated with carotenoids, carotenes and β -carotene content in *B. rapa* for screening of genetic resources collections and breeding material. Identification of loci associated with valuable traits facilitates marker-assisted selection to increase crop productivity and quality.

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