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Genetic control of leafy heads by microRNAs

eafy head is one type of important vegetable product composed of incurved leaves. Several crops producing leafy head show the leaves with downward curvature, flatness and incuvature at seedling, rosette and heading stages, respectively. Physiological studies have shown that the formation of leafy head is affected by internal elements such as C/N ratio and source/sink ratios and environmental factors such as temperature, light intensity and photoperiod. However, genetic basis for formation of leafy heads is unclear. In the previous study, we used flat and incurved leaves of Chinese cabbage to isolate BcpLH (Brassica campestris ssp. pekinenesis LEAFY HEADS) gene from a cDNA library by differential hybridization. By Agrobacterium-mediated transformation, we transferred brp-miR319a gene to a round-head variety. In the transgenic lines, miR319a-targeted genes were down-regulated, while the round heads were modified into oblong heads. In the head leaves of the transgenic plants, TCP genes were downregulated by exogenous miR319a. The marginal regions of lateral areas in these head leaves were extremely wavy and knotted, apparently due to prolonged and enhanced cell division and vein differentiation in hydathode regions. The accumulation and distribution of miR319a in head leaves affect head shape, and artificial miR319a is useful for genetic improvement of head shape for favorable vegetable products. On the other hand, we found that BrpSPL9-2 (Brassica rapa ssp. pekinensis SQUAMOSA PROMOTER BINDING-LIKE 9-2), a target gene of microRNA brp-miR156, controls the heading time of Chinese cabbage. Overexpression of a miR156-resistant form of BrpSPL9 caused leaf curvature (folding) to occur much earlier, causing early time of leaf heading. By contrast, overexpression of miR156 delayed leaf curvature so it occurred in later leaves, resulting in a delay of leaf heading. BrpSPL9 genes control heading time by accelerating adult development, and thus are potentially important for genetic improvement of earliness of Chinese cabbage and other crops. Our indings suggest that BcpLH serves for downward curvature of seedling leaves, flatness of rosette leaves, and incurvature of heading leaves, and is hence required for formation of leafy heads.

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