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Inheritance of C_3-C_4 Intermediate Photosynthesis in Reciprocal Hybrids between *Moricandia arvensis* (C_3-C_4) and *Brassica oleracea* (C_3) that Differ in their Genome Constitution

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Abstract: To elucidate the genetic mechanisms underlying C_3-C_4 intermediate photosynthesis, we investigated the structural and photosynthetic characteristics of leaves of reciprocal hybrids between the C_3-C_4 intermediate species *Moricandia arvensis* (L.) DC. (MaMa) and the C_3 species *Brassica oleracea* L. (cabbage; CC), which differ in genome constitution. *Moricandia arvensis* bundle sheath (BS) cells included many centripetally located chloroplasts and mitochondria, whereas those of cabbage had few organelles. Hybrid leaves were structurally intermediate between those of the parents and showed stronger intermediate C_3-C_4 features as the proportion of the Ma genome increased. The P-protein of glycine decarboxylase (GDC) was confined mainly to BS mitochondria in *M. arvensis*, but accumulated more in the mesophyll (M) of cabbage. In the hybrids, the accumulation of GDC in BS cells increased with an increasing Ma:C ratio. Hybrids exhibited gradients in structural and biochemical features, even in reciprocal crosses. The CO_2 compensation point of reciprocal hybrids with high Ma:C ratios was lower than that of cabbage but higher than that of *M. arvensis*. Thus, the structural and biochemical features in

hybrid leaves reduced photorespiration. *Moricandia arvensis* had a higher photosynthetic rate than cabbage, but the photosynthetic rates of hybrids were intermediate between those of the parents or comparable to that of *M. arvensis*. Our results demonstrate that the C_3-C_4 intermediate characteristics are inherited based on the ratio of the parent genomes, and that there is no evidence of cytoplasmic inheritance in these characteristics.

Keywords: Brassicaceae, C_3 species, C_3-C_4 intermediate species, CO_2 exchange, Glycine decarboxylase, Leaf anatomy, Photorespiration, Reciprocal hybrids

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