灰系統理論在生物學之應用：

(III)葉黃素循環與酚酸代謝物對植物葉片熱能消散之比較

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摘要

本研究引用 Close 和 Beadle(2003)報告中之資料及應用灰關聯理論(Deng, 1982)，比較高等植物葉片面對過量光能時，其葉黃素循環與酚酸代謝物對能量消散之貢獻度。以光化學效能(photochemical efficiency)Fv/Fm 為實驗系列，而以為葉黃素循環規範(xanthophylls cycle-engagement, XC-E)、非光化學冷卻(non-photochemical quenching, NPQ)及三種酚酸化合物(即 flavonoids、galloylglucoses 及 sideroxylonals)之含量變化為參考系列，進行灰關聯分析。灰關聯度及灰序顯示，三種酚酸化合物對 Fv/Fm 之貢獻度都大於葉黃素循環；亦即葉黃素循環對葉片散熱過程的貢獻度均比酚酸代謝物大。因此推論，若二者均對葉片散熱提供機制，可能是以葉黃素循環為主，而以酚酸代謝物為輔。

關鍵詞：灰關聯理論、葉黃素循環、酚酸代謝物、能量消散、貢獻度、灰關聯分

析

Application of grey system theory on biology: (III) the xanthophyll cycle attributes more than phenolic metabolites to energy dissipation

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Abstract

The object of this paper was conducted to determine the contribution degree of the xanthophylls cycle and phenolic metabolites in light energy dissipation of leaves based on the experimental data (Close and Beadle, 2003). The grey relational analysis was applied to compare the contribution degree. Photochemical efficiency (Fv/Fm) was treated as experimental series data and the levels of non-photochemical quenching (NPQ), three phenolic metabolites such as flavonoids, galloylglucoses, and sideroxylonals, as test series data. Grey relational values and grey order after mean normalization suggest that phenolic compounds make more contribution to Fv/Fm than xanthophylls cycle; In contrast, xanthophylls cycle plays the major role in energy

dissipation and phenolic compounds the minor, if both get involved in excess light energy dissipation.

Key word: contribution degree, energy dissipation, grey order, grey relational analysis, grey relational values, grey system theory, phenolic metabolites, xanthophylls cycle.