

# Spatio-Ecological Factors Affecting Pyrethrin Content in Natural Populations of Dalmatian Pyrethrum

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**Abstract**— Pyrethrin is a mixture of six compounds (pyrethrin I and II, cinerin I and II, jasmolin I and II) with high insecticidal potential. Due to the low toxicity to humans and high efficiency in dealing with various insect species, they are often used in organic pest management. Pyrethrins are extracted from the flower heads of Dalmatian pyrethrum (*Tanacetum cinerariifolium* /Trevir./Sch. Bip.), species endemic to the eastern coastline of Adriatic sea.

In this study, a recently optimized matrix-solid phase dispersion method (MSPD) was used to extract the pyrethrins from samples of five Dalmatian pyrethrum natural populations. The samples were collected along the Croatian coastline. Separation and quantification of pyrethrin components were performed using high-performance liquid chromatography with diode array detector (HPLC-DAD). Pearson's correlation index was calculated between pyrethrin components, and differences between the populations using the analysis of variance were tested. Additionally, the correlation of each pyrethrin component with spatio-ecological variables was calculated.

A significant difference between populations based on total pyrethrin content was determined. Results revealed a high variability within and among populations regarding the pyrethrin content. Total pyrethrin content varied from 0.10% to 1.24% of dry flower weight. On average, the highest total pyrethrin content was observed in population from Mali Lošinj (0.87% of dry flower weight) and lowest in population from Pelješac (0.22% of dry flower weight). A trend was observed in the decrease of the pyrethrin I content, total pyrethrin content as well as pyrethrin I to II ratio (a major indicator of pyrethrum extract quality) with lower geographical latitude. This might be contributed to a long tradition of pyrethrum cultivation and selection for higher pyrethrin yield in the northern parts of Adriatic (mainly islands Krk, Cres, and Lošinj). The pyrethrin II content increased with lower geographical latitude. The existence of a strong negative correlation between pyrethrin I and pyrethrin II, cinerin II, and jasmolin II was determined. Mt. Biokovo population exhibited a unique chemical profile when compared to the rest of the populations in the sample. In the Mt. Biokovo population, pyrethrin II was the dominant component (43.18% of total pyrethrin content) while in all other populations the dominant component was pyrethrin I (up to 60.47% of total pyrethrin content in Mali Lošinj population).

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Furthermore, a strong negative correlation between pyrethrin II and bioclimatic variables pertaining to temperature, and a strong positive correlation between pyrethrin II and elevation, as well as distance from the coastline was determined. The combination of geographical and genetic isolation from other populations (several micropopulations found at 1600 meters above sea level) and harsher climate conditions (lower temperatures and higher precipitation) clearly affect biosynthetic pathways of pyrethrin production in plants from Mt. Biokovo population, leading to such altered chemical profile. The cultivation of pyrethrum in Croatia was always limited to the coastline since its ecological distribution is predominantly conditioned by the Mediterranean climate. Considering this, the Mt. Biokovo population is a perfect candidate for breeding programs aimed at developing cultivars that would not only survive but also thrive in continental climate conditions.

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