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Phytohormone response to cold plasma in seeds, leaves and flowers

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Seed irradiation with cold plasma (CP) can positively affect germination, plant growth, the efficiency of photosynthesis, primary and secondary plant metabolism, stress resistance, yields, and production quality. The molecular machinery of CP action is complex and contains different types of still unelucidated signal perception, transduction mechanisms, and resulting metabolic changes. Phytohormones, the diverse group of highly active substances that function as key regulators of virtually all plant processes, are one of the main players in plasma-induced effects in plants. This study aimed to determine the effect of CP on the pattern of phytohormones in seeds and young seedlings in red clover, as well as in later vegetation stage leaves and flowers of common buckwheat. The amounts of the active forms of seed phytohormones (abscisic acid, ABA; auxines, IAA; citokinins, CK; jasmonates, JA, etc.) in red clover (cv. 'Arimaičiai') seeds and leaves of 15-day-old seedlings were investigated. Seeds were treated with capacitively-coupled low-pressure plasma (CC) for 3 and 7 min, and vacuum for 7 min (CC3, CC7, and V7 groups). Phytohormones were detected by LC/MS after separation on a reverse-phase–cation exchange SPE column into the acid and basic fractions. Seed treatment with CC7 and V7 reduced ABA (the main germination inhibiting phytohormone) and IAA amounts. In seedling leaves, CP7 decreased ABA-GE conjugate content, V7 increased IAA, and induced other complex changes. In field-grown 8-week-old common buckwheat (cv. 'VB Nojai'), the effects of V7, CC7, and DBD2 (2-min seed treatment with dielectric barrier discharge plasma) were focused on gibberellins (GAs) in leaves and flowers. CC7 and DBD2 increase the amount of biologically active GA4 and precursor GA20 in leaves and biologically active GA1 (only DBD2) and GA20 and catabolite GA29 in flowers. The obtained results reveal that changes induced by treatments in seed phytohormone composition are followed by a complex pattern of changes in amounts of phytohormones (key regulators of growth and development) in the leaves and flowers of the growing seedlings, further resulting in morphometric and biochemical changes in plants.

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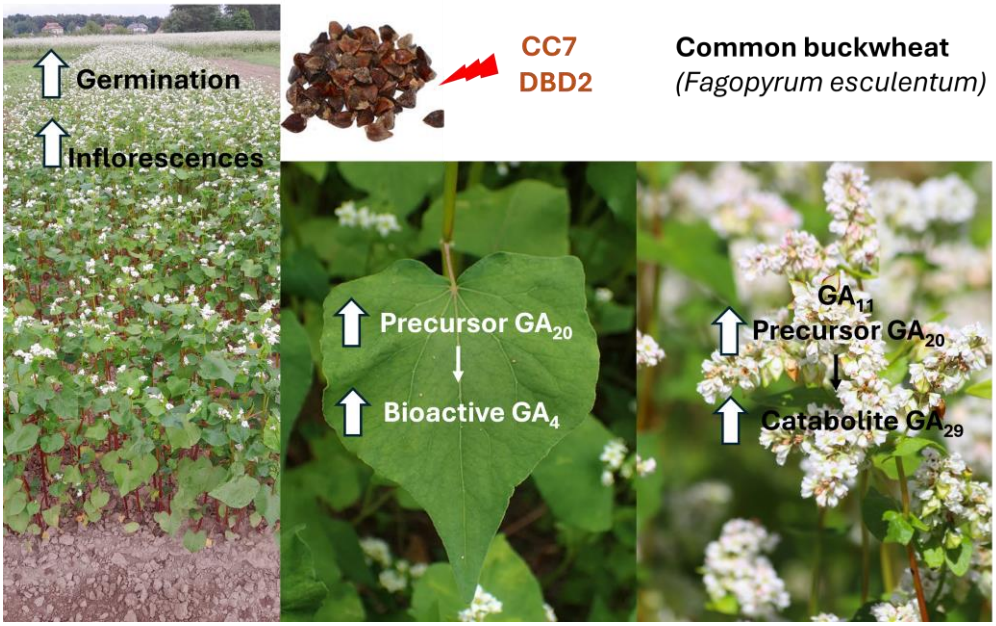

Figure 1. Changes in common buckwheat (*Fagopyrum esculentum*) leaves and flowers' phytohormone concentrations induced by seed treatment with CC (7 min, CC7) and DBD (2 min, DBD2) plasma (field experiment).