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Genetics and Biochemistry of Plant Cannabinoid Synthesis and Biotechnology Challenges

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Description

Tetrahydrocannabinol, or THC, is the psychoactive secondary component that makes Cannabis sativa most well-known. However, this medical plant contains a variety of phytocannabinoids, of which THC is just one. Scientific interest in the genetics and biochemistry of phytocannabinoid production has increased as a result of the gradual legalization of cannabis in many nations, which has created prospects for both medical and commercial applications Although research on cannabis is currently lagging behind that of other high-value commodities, it is picking up speed because of advancements in plant biology and genomics. Here, we discuss the intriguing evolutionary history and genetics of phytocannabinoid synthases. We also demonstrate how crucial it is to gain a better grasp of the embryonic genetics and morphology of cannabis in order to fully use the production of phytocannabinoids. Cannabis sativa, commonly referred to as cannabis, has been dubbed the "plant of the thousand and one molecules." The most prevalent substances in cannabis are phytocannabinoids, along withterpenes and flavonoids. There are already over a hundred phytocannabinoids that have been identified, among which Tetrahydrocannabinol (THC) and Cannabidiol (CBD) are just two.

Phytocannabinoid synthesis and biotechnology

The term "phytocannabinoid" refers to cannabinoids that are obtained from plants and is used to differentiate them from cannabinoids that are created by other creatures, such as the cannabinoids found in the human endocannabinoid system. THC is a psychoactive substance that has been used for thousands of years for both spiritual and recreational purposes. Nonetheless, during the past years, it has become more evident that Tetrahydrocannabinol (THC), Cannabidiol (CBD) and other phytocannabinoids may be used to treat cancer as well as mental and neurological conditions. These results have raised interest in studying the morphology and development of the related plant structures, the biochemistry of phytocannabinoid synthesis and its underlying genetics and the evolutionary origins of the synthases. Recent developments in various fields are outlined in this article along with their implications for plant biotechnology and breeding. Four phytocannabinoid synthases Cannabigerolic Acid Synthase (CBGA synthase), tetrahydrocannabinolic acid synthase (THCA synthase), Cannabidiolic Acid Synthase (CBDA synthase), and Cannabicromenic Acid Synthase (CBCA synthase)-further metabolize the various precursor molecules that are a part of the plant's multistep phytocannabinoid synthesis. While THCA, CBDA and CBCA synthases are all closely related oxidocyclases, CBGA synthase is a prenyltransferase.

Phytocannabinoid synthesis mechanisms

Transposable elements are scattered among clusters of synthase and synthase-like pseudogenes (grey boxes) that encode phytocannabinoid synthases. Two major haplotypes are typically found: One that encodes a functioning THCAS (blue), the other that encodes a functional CBDAS (green) and both that encode a functional CBCAS (orange A person who generates THC as their predominant cannabinoid (referred to as "THC-dominant") synthesizes THCA, the precursor of THC, when THCAS is expressed. THC-CBD mixed people are produced when both haplotypes are present because active THCAS and CBDAS are expressed. Marijuana includes both THC-dominant and THC-CBD mixed plants. The plant is referred to as hemp or CBD dominant if it solely has the haplotype that codes for CBDAS, which indicates that CBDA is the predominant cannabinoid. An active CBGA synthase found in nearly all cannabis plants synthesizes precursor molecules into CBGA, which is then converted into THCA or CBDA .

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