What steps in the cannabinoid biosynthetic pathway rate-limit CBD production?

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The draft genome and transcriptome of *Cannabis sativa*

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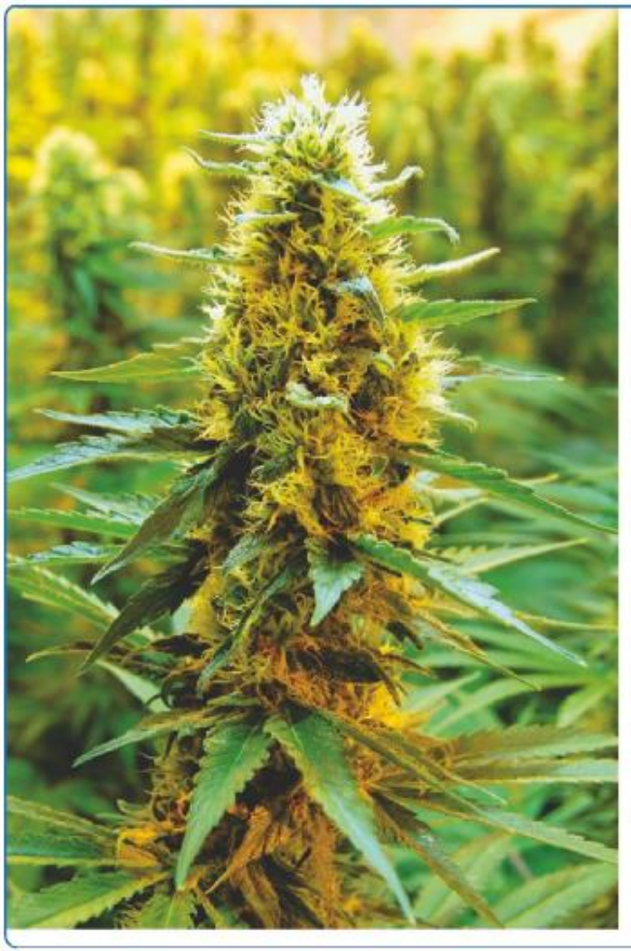
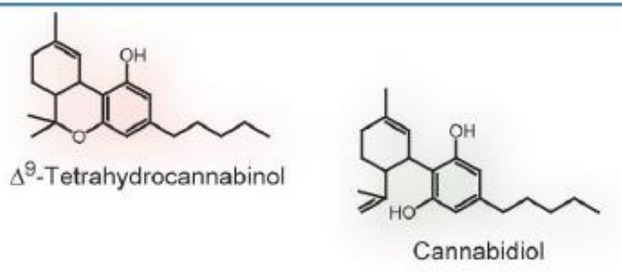
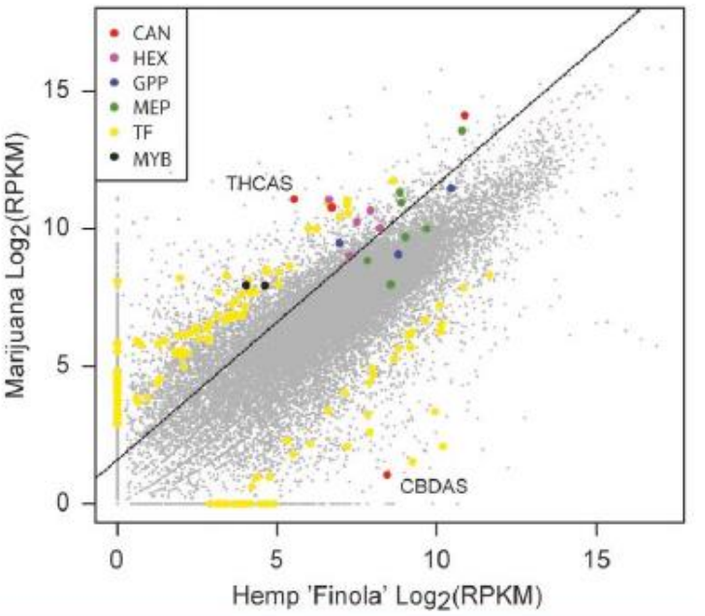
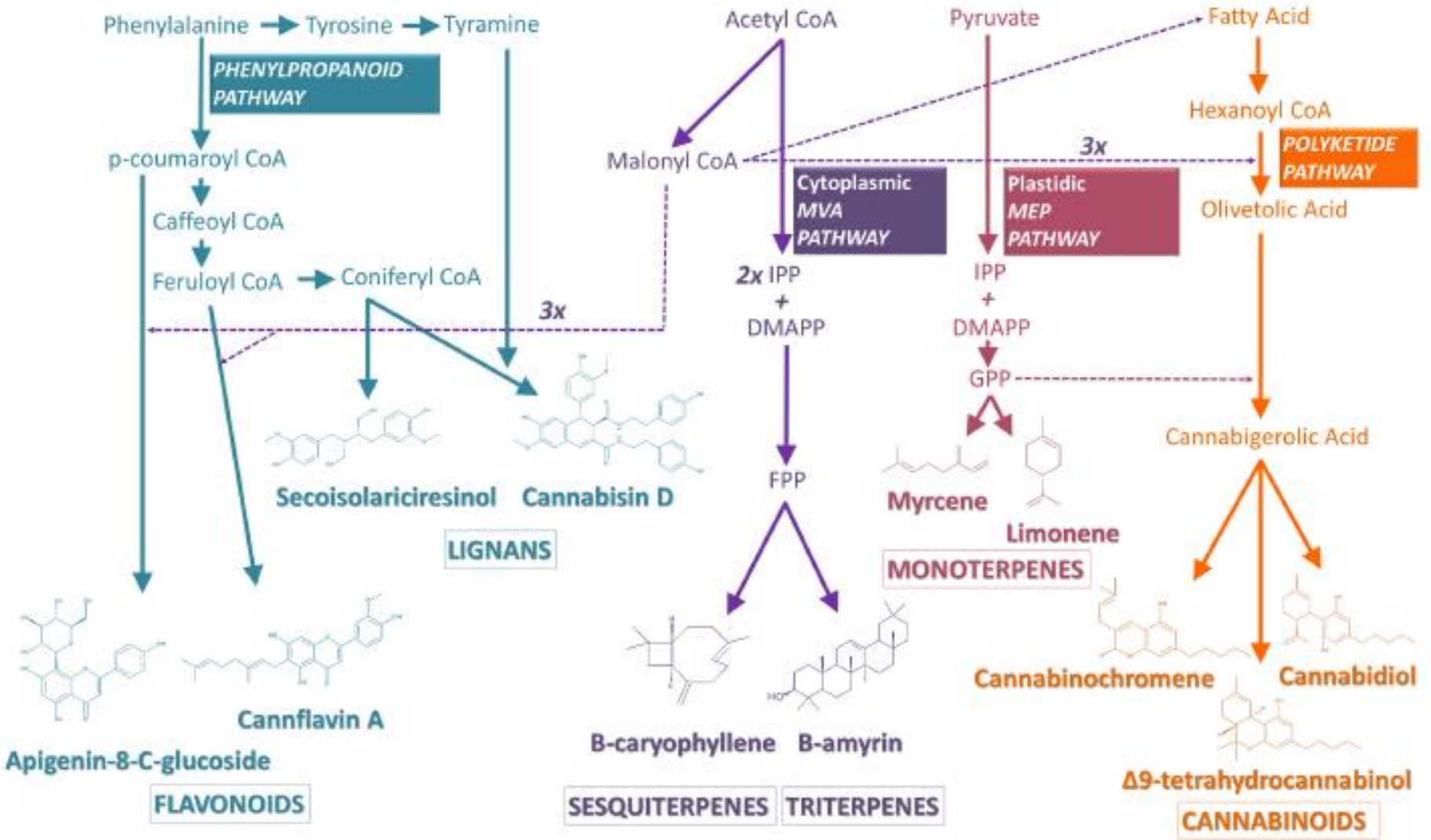
Genome Biology



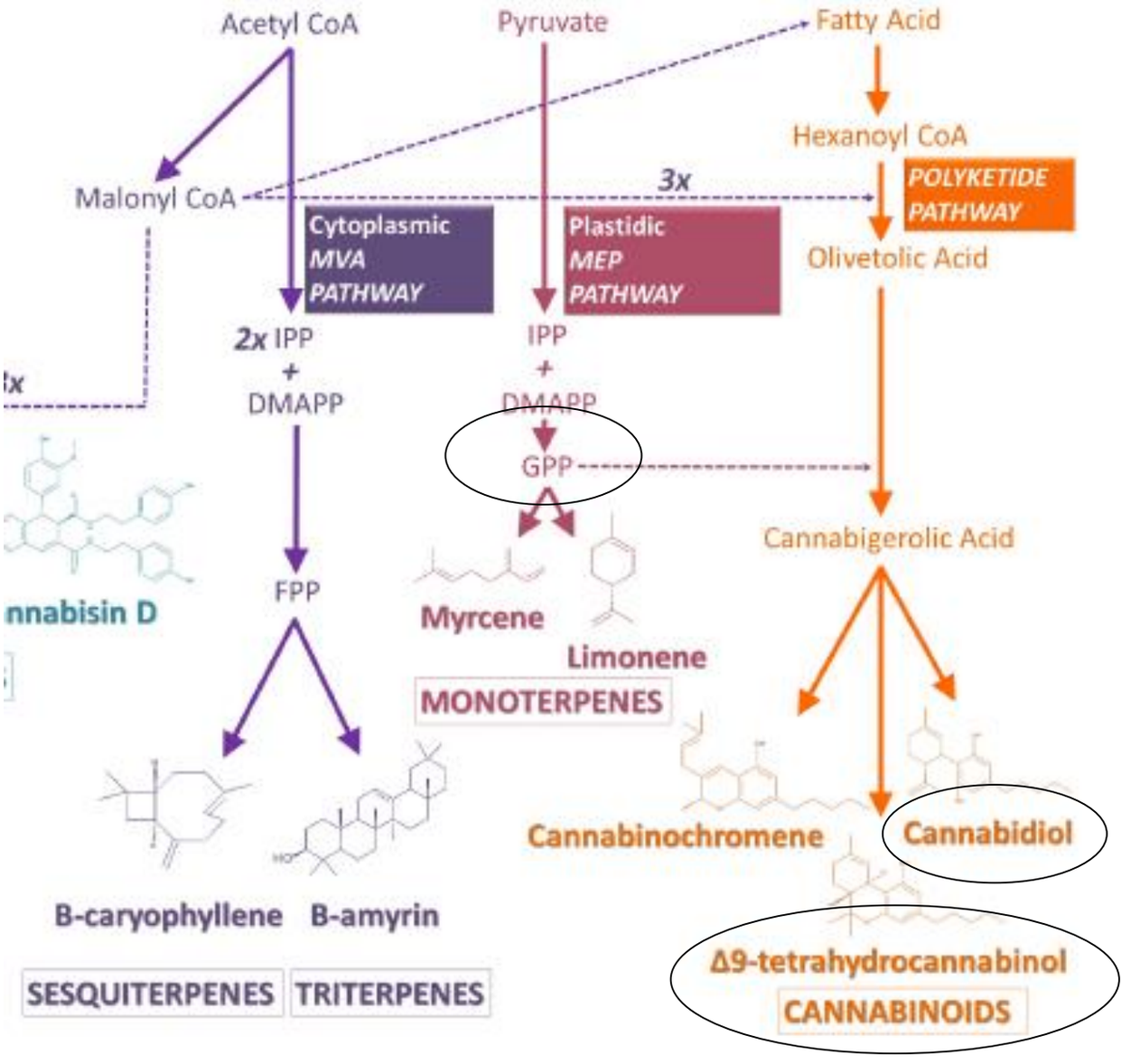




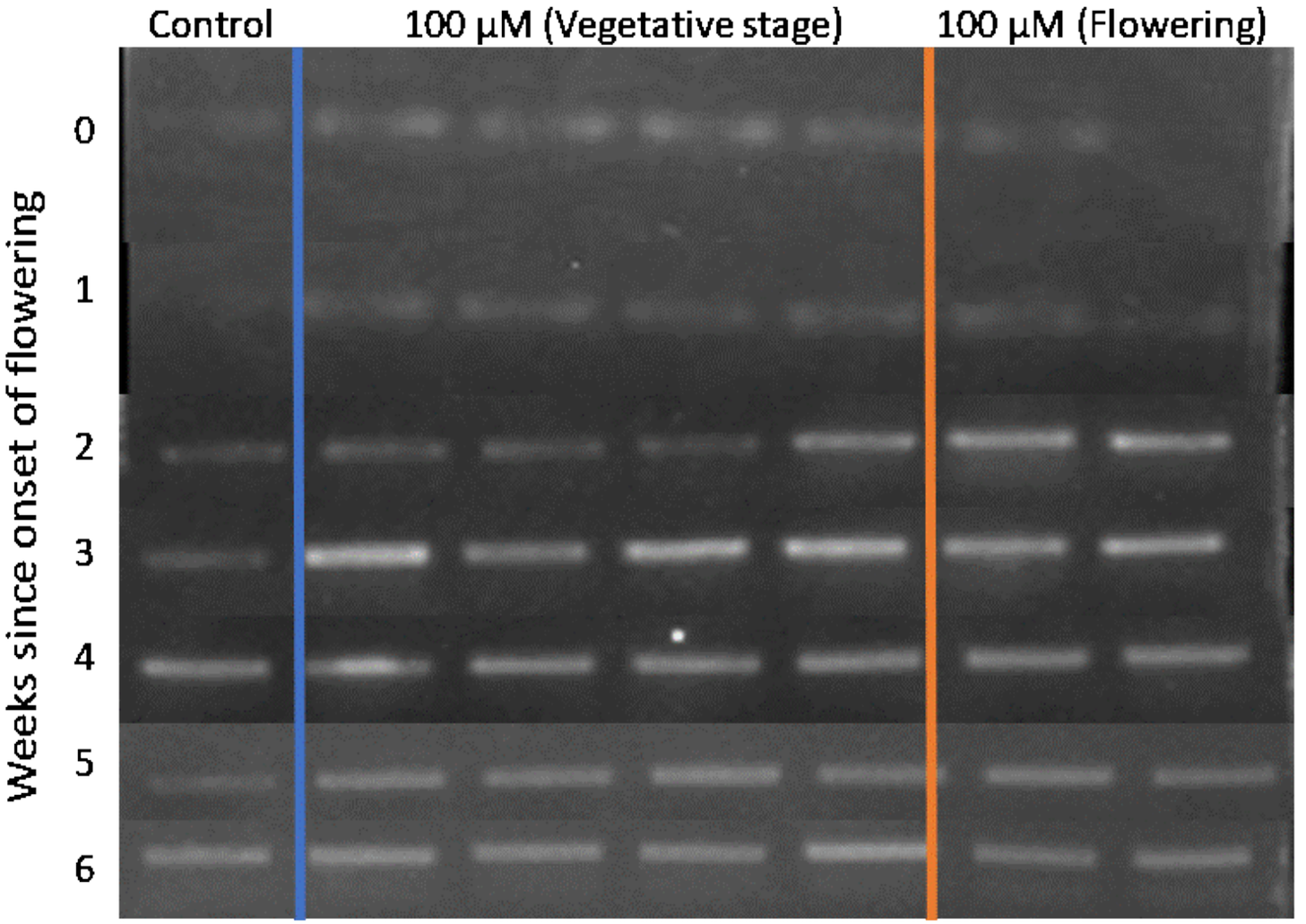
Molecular manipulation of Cannabis. Knowledge about the Cannabis genome provides an opportunity to edit genes, identify/alter promoter elements, shift carbon flow between competing pathways, clone relevant genes (heterologous expression), screen genotypes for disease resistance, link genes to production restraints (controlled environment and field)



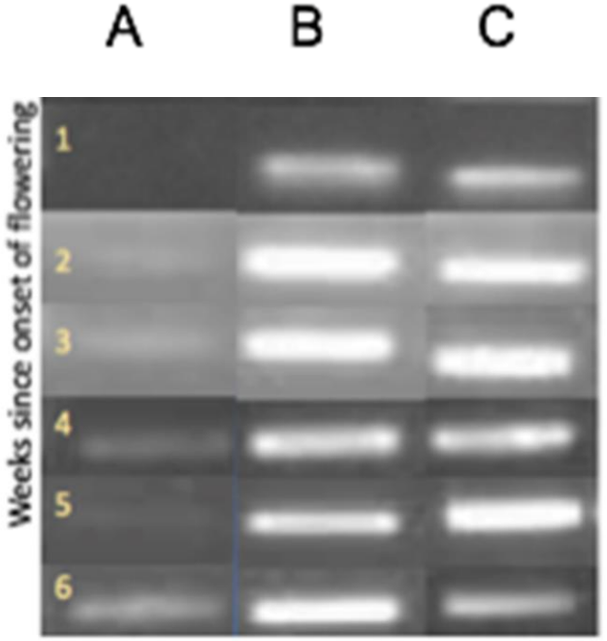
What we already suspect: (1) CBDaS has ethylene-responsive promoter elements, THCaS does not. We can use growth regulators to alter production. (2) Induction of male sterility and/or seed feminization in varieties grown from seed could reduce costs. (3) We can knock out cannabinoid synthesis to allow native terpene profiles from elite strains to be easily purified. (4) We can shift carbon flow from monoterpenes to cannabinoids. (5) We can alter the promoter of THCaS. (6) We can use CRISPR to edit THCaS and completely abolish THC production in elite strains of CBD hemp.



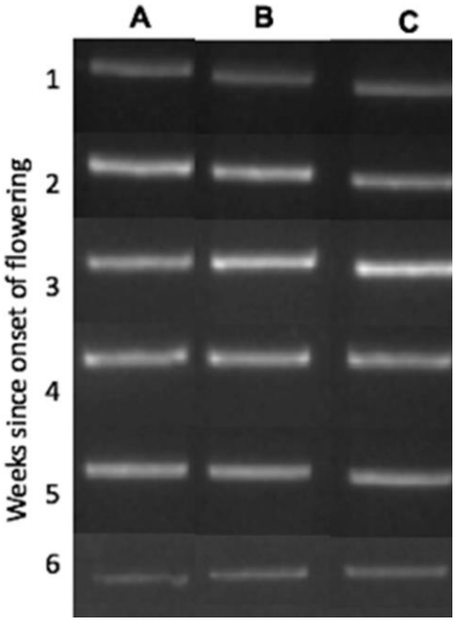
Ethephon application results in ethylene-dependent changes in *Cannabis sativa* plants. Ethylene-Response Factor (EFR1) is up-regulated at an earlier point, and to a greater extent in Cannabis flowers by application of the gaseous hormone



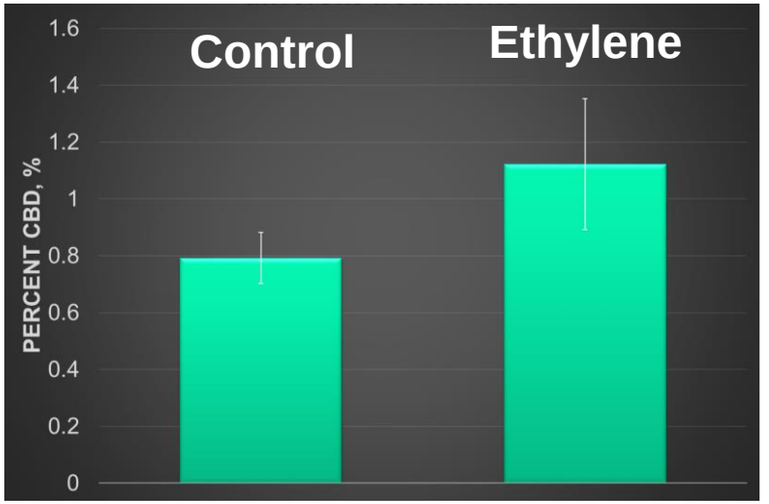
Application of the growth regulator ethylene to Cannabis increases flower size, CBDaS expression, and female flower CBD content.



CBDa synthase expression

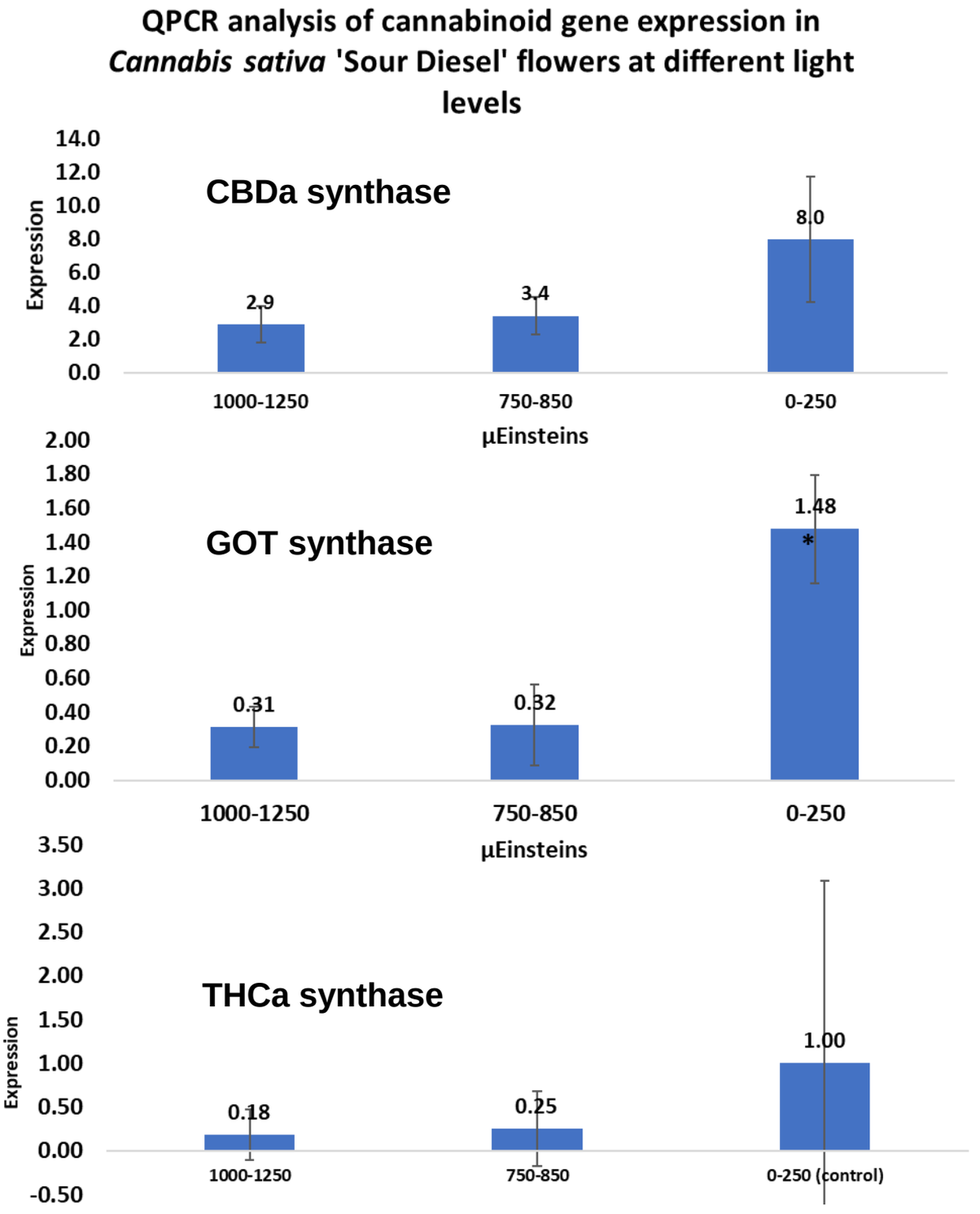


GOT expression



CBD content (mg/g flower)

How does your garden grow? Do you know the performance of your flower canopy?



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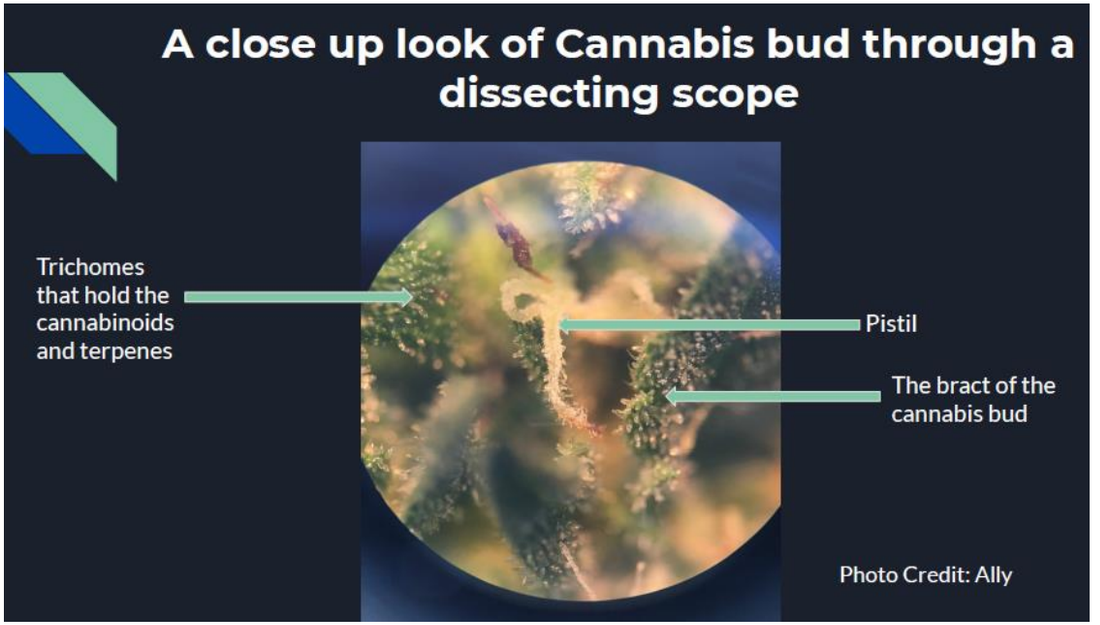
RAPID COMMUNICATION

METHYL JASMONATE APPLICATION INDUCES INCREASED DENSITIES OF GLANDULAR TRICHOMES ON TOMATO, *Lycopersicon esculentum*



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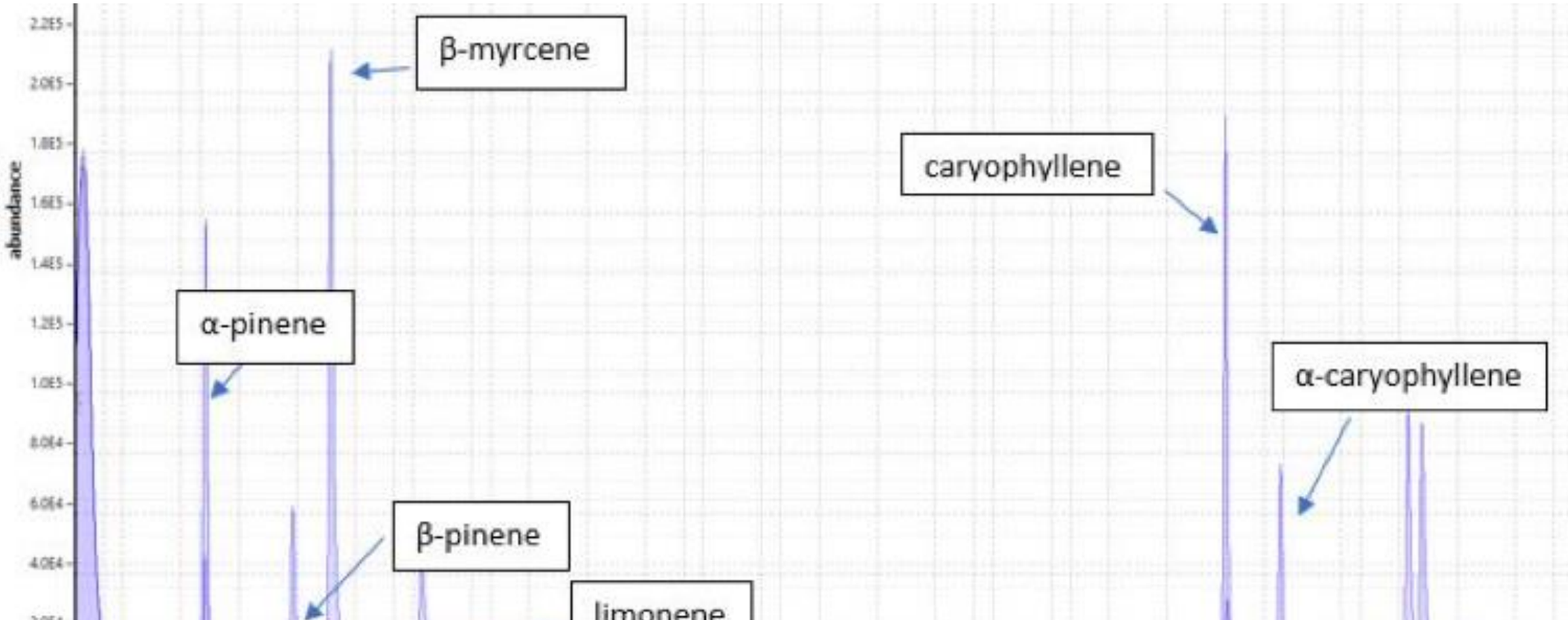
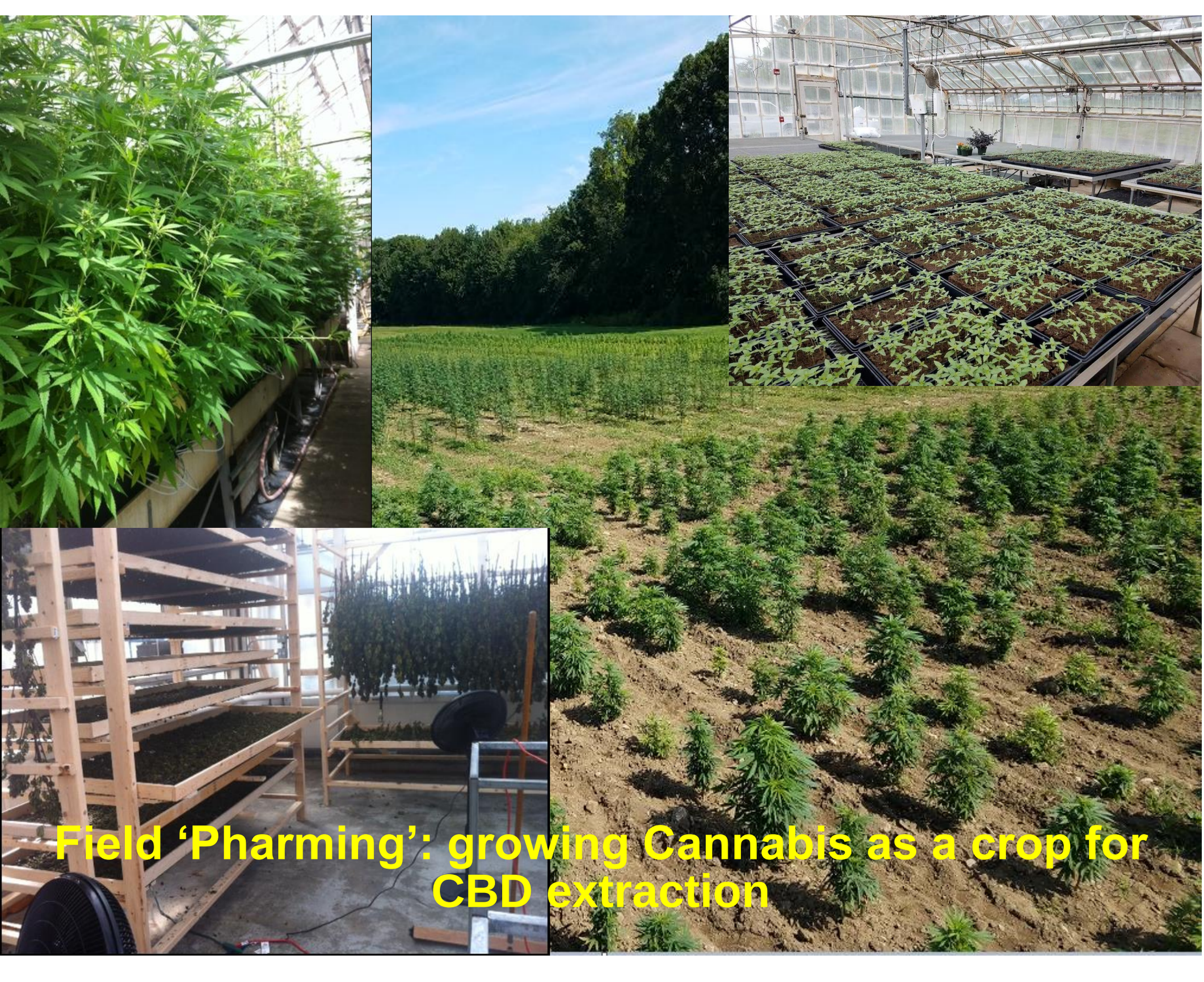
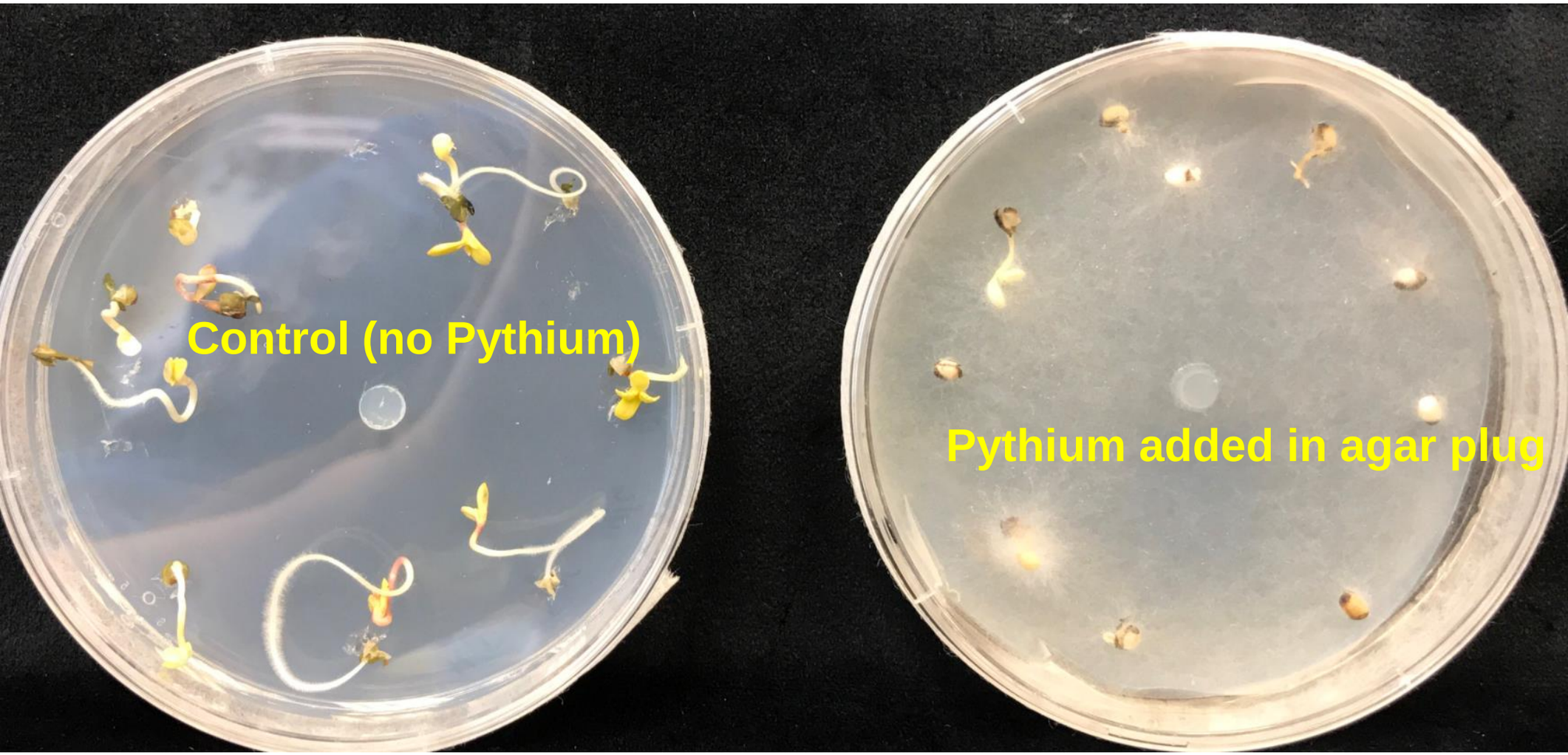
HIGH-RESOLUTION MEASUREMENTS IN PLANT BIOLOGY

Glandular trichomes: what comes after expressed sequence tags?

Gas chromatography mass spectrometer chromatograph showing the terpene profile and relative abundance of 7 common terpenes found in C. sativa plants. Also included in the chromatograph is the presence of various napthalenes which are given off in the vaporization process of the terpenes in the inlet of the GC- MS. All work was done on an Agilent 5975 GC- MS using a JW scientific DB1 column 12 meters x .2mm inner diameter x .33um film.



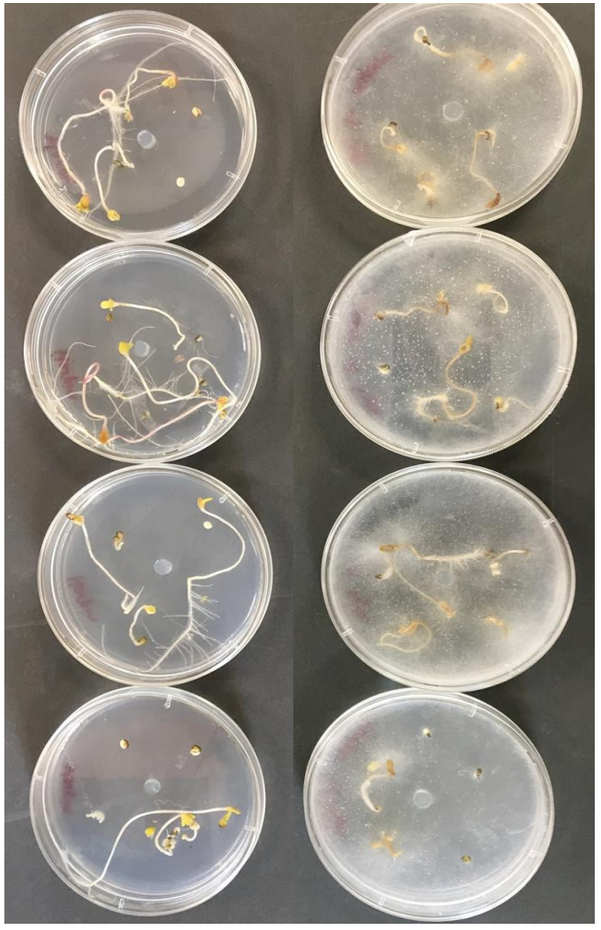

Field ‘Pharming’: growing Cannabis as a crop for CBD extraction


Control (no Pythium)
Pythium added in agar plug

RX GREEN TECHNOLOGIES
RESULTS DELIVERED.

Controlling diseases without pesticides

Germinating seeds in the presence of a pathogen: an easy screen



Overnight exposure of seeds to a PAMP (harpin) reduces pathogen-induced seed mortality

	Harpin soak | water media	Harpin soak | Harpin in media	Water soak | Harpin in media	Water soak | no harpin in media
Mortality (%)	0	0	4.7	30

Seedling growth in the presence of pathogen is also enhanced by PAMP treatment