CO2 and UV light vs Pseudomonas syringae

Posted by Karn Piana
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Karn Piana
CO2 and UV light vs Pseudomonas syringae
June 16, 2018 04:58AM
Registered: 5 years ago
Posts: 77

Bacterial Canker (Pseudomonas syringae) appears to inhibit photosynthetic CO2 assimilation. Perhaps there are fungal pathogens which also have integral relationships to CO2 and UV levels. Various chemical approaches involving both biologic, organic, and conventional procedures have been employed in attempts to mitigate or stop these outbreaks, but thus far the results have apparently left much room for improvement. Results such as these are invitations to experiment and consider alternatives.

If bacterial canker interferes with photosynthetic CO2 assimilation, would it not be interesting to observe what would happen if these inputs were supplied artificially in order to help the plant's immune system to overcome the disease.

A tipi comprised of electric emt conduit would be erected over a dwarf or semi dwarf tree and a 6 mil polyethylene sheathing would be installed over this structure to create a quasi hermetic environment in which CO2 levels could be modulated. In addition, a UV disinfecting lamp could be suspended from the apex of the tipi and additional stoma directed lamps could be installed below. The tipi would encompass the drip line of a tree which would allow additional dimensions of interaction with the local rhizosphere.

A modified high tunnel could also be easily employed.

A test regimen might resemble the following:
*Reinocculation of rhizosphere with beneficial fungi and bacteria.
*Creation of sporulation conditions inside of the tent by fogging with water.
*Immediately following sporulation conditions, UV lamps are employed to kill pathogens. This is a similar idea to wild flower reseeding efforts which employ plastic sheeting to germinate and destroy dormant weed seeds in order to create a sterile substrate.
•After UV phasing, the holistic protocol is employed as a fog to competitively colonize stoma and crevice.

There is horticultural precedent with the use of CO2 tents and portable CO2 generators are made for this purpose. My initial concept involved a hypothetical trip to the welding supply store, but there are obviously far more accurate and effective ways of controlling CO2 levels as it appears people have been doing this for awhile. Studies of CO2 level modulation have produced conflicting results: some anecdotes and studies report 30% in growth with greater than 1500 ppm CO2. Other studies report varying response contingent upon species, but also increases in stoma size on some plants which create more infection susceptible anatomy. I haven't had time to read this article, but a cursory glance seems to indicate some viral increases with heightened levels of CO2, although I believe this study is looking at increased atmospheric CO2 levels over time as opposed to the use of CO2 and light as part of a healing regimen.

Anyway, the point of my writing is to generate conversation and perhaps help inspire a new idea in others on this forum. This may be a ridiculous idea, it may have already been done, that's fine. Feel free to say so and share why.

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Karn Piana
Red Precedents
June 26, 2018 08:24AM
Registered: 5 years ago
Posts: 77

Pseudomonas syringae Contra Lumen

The concept of treating Pseudomonas syringae using UV light has scientific precedent, shows legitimate potential as an effective treatment, and may warrant further consideration as another dimensional component to a Holistic approach to agriculture.

I thought I read somewhere on this forum or in another study of P. syringae that there was some kind of relationship or initiation between

this bacteria and pathogenic nematodes. A search for "nematodes and Pseudomonas syringae" led me to the linked research paper above describing an experiment using UV light in the far red spectrum to induce systemic acquired resistance (SAR) states in plants against root-knot nematode (Meloidogyne javanica) and P. syringae.

There is precedent for induction of disease resistance using red light and there are several reports outlined, but the molecular mechanisms at work remain an enigma.

There are several tantalizing takeaways from this paper that I'm going to attempt to summarize.

•Red light irradiation at night induced greater levels of resistance.

•Pseudomonas fluorescens bacteria has been demonstrated to induce SAR in several plant species against P. syringae, as well as Fusarium oxysporum, a fungal root pathogen.
From wikipedia, "Some P. fluorescens strains (CHA0 or Pf-5, for example) present biocontrol properties, protecting the roots of some plant species against parasitic fungi such as Fusarium or the oomycete Pythium, as well as some phytophagous nematodes. It is not clear exactly how the plant growth-promoting properties of P. fluorescens are achieved; theories include:
The bacteria might induce systemic resistance in the host plant, so it can better resist attack by a true pathogen.
The bacteria might outcompete other (pathogenic) soil microbes, e.g., by siderophores, giving a competitive advantage at scavenging for iron.
The bacteria might produce compounds antagonistic to other soil microbes, such as phenazine-type antibiotics or hydrogen cyanide.

•The paper describes the Systemic Acquired Resistance state coinciding with an endogenic (growing or originating from within) synthesis of salycylic acid (SA) (think asprin and willow water) Evidently, there is a known precedent for SA to play a crucial role in plant defense signaling responses against attack. This is interesting.

The paper goes on to outline the experiment and to conclude that the red light UV reduces bacterial infection through a SA pathway and the root nematode through an SA independent pathway.

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Karn Piana
Phasing Darkness and Spectral Effect
July 03, 2018 07:32AM

Registered: 5 years ago
Posts: 77

Here is an article that surveys the use of UV-C as an anti fungal / anti pathogenic tool in high tunnel production agriculture and also describes an experiment on the efficacy of a period of darkness following UV-C treatment. The gist of the experiment was to infect strawberries with necrotrophic gray mold (Botrytis cinerea), hit one group with UV-C and hit another with the same exposure of UV-C followed by a dark period of up to two hours. The result was that most of the pathogen was destroyed and a substantially greater efficacy was observed when the irradiation was followed by a dark period.

"Maintaining a dark environment after exposure to a damaging UV-C irradiation can prevent light activation of the DNA repair mechanism in microorganisms"

A side effect of chlorophyl damage was observed.

Secondly:

The effects of different light wavelengths in the visible spectrum have different effects on plants. I'm going to write down a rudimentary list of color and effect, but there is obviously tremendous nuance and possible potential here and this is worth exploring more deeply...

BLUE:
A relatively high energy spectrum with powerful effects on growth. Here is an article on blue light by Erik Runkle. From the article, "Generally, blue light suppresses extension growth; plants grown with blue light are usually shorter and have smaller, thicker and darker green leaves compared to plants grown without blue light (Figure 1). In the production of ornamentals, these attributes can be desirable because in essence, blue light can act as a growth regulator. The utility of blue light as a growth regulator is pronounced with indoor lighting and generally has less or no growth-inhibiting effects in supplemental greenhouse lighting. There are some reports in which extension growth is actually promoted under only blue light, although this response seems to be crop specific."

RED:
A longer wave form, less energy than blue. PR1 gene activation and salycilic acid healing response (cited in prior post).

YELLOW and GREEN:
The least absorbed light spectrums and those with the least apparent role in plant life.

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Karn Piana
Modulated Antagonism
July 03, 2018 08:38AM
Registered: 5 years ago
Posts: 77

There is an article in The Journal of Experimental Botany describing elevated levels of CO2 favoring endogenic salicylic acid production (PR1 gene?) and a repression of Jasmonic acid production. Wikipedia describes the role of Jasmonic acid as, "The major function of JA and its various metabolites is regulating plant responses to abiotic and biotic stresses as well as plant growth and development."

The article describes an experiment whereby tomatoes inoculated with Pseudomonas syringae were induced into a Systemic Acquired Resistance (SAR) state (this time brought about by heightened levels of CO2 rather than red light) which caused the complete destruction of the pathogen. Interestingly however, the paper describes the relationship between salicylic acid and jasmonic acid as a "modulated antagonistic relationship" and the salicylic acid dominate tomatoes were subsequently more susceptible to necrotrophic Botrytis cinerea due to the repression of the JA pathway.

As the prior post shows, Botrytis cinerea is highly vulnerable to UV-C irradiation and there is a potential protocol of countering this secondary tier of infection with light.

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Karn Piana
Regarding Green Immunity
July 11, 2018 02:10AM
Registered: 5 years ago
Posts: 77

Michael Phillips has a great article discussing SAR (Salicylic Acid), and ISR (Induced Systemic Response / Jasmonic Acid) in the January 2015 edition of The Community Orchardist here. There is a discussion on this forum regarding this article under Fungal Pathogens called Green Immune Function here.

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