Acta Scientific AGRICULTURE (ISSN: 2581-365X)

Volume 6 Issue 8 August 2022

Editorial

Flashes of Ultraviolet Light: An Innovative Method for Stimulating Plant Defenses to Fungal Diseases

Abdelhak Rhouma*

Higher Agronomic Institute of Chott Mariem Sousse, University of Sousse, Sousse, Tunisia

***Corresponding Author:** Abdelhak Rhouma, Higher Agronomic Institute of Chott Mariem Sousse, University of Sousse, Sousse, Tunisia.

Received: May 31, 2022

Published: July 01, 2022

Life on Earth is exposed to a variety of light spectrum from ultraviolet-B to wavelengths, called natural radiation. The electromagnetic spectrum ultraviolet (UV) consists of 3 classes: UV-A (315-400 nm), UV-B (280-315 nm) and UV-C (200-280 nm), with UV-A and UV-B reaching only the surface of the earth. UV radiation affects plants and fungal pathogens by altering the relationship between them (Figure 1). In this paper, we study the applicability and the effect of ultraviolet radiation on plant protection against phytopathogenic fungi. Thus, this review offers a comprehensive overview to help growers and scientists to create informed decisions for ultraviolet treatments in various applications [1-3].

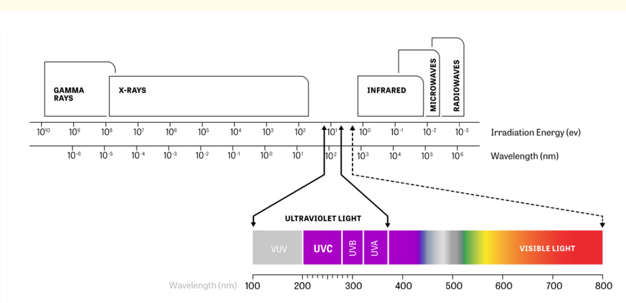

Figure 1: Diagram showing the ultraviolet portion of the solar spectrum.

Ultraviolet treatment of plants can lead to improved resistance to plant pathogens in diverse ways. For the direct effects on the phytopathogenic fungi to be effective, the radiation needs to reach the phytopathogenic fungi that is to be eliminated. Ultraviolet-C is most powerful in reducing the infection pressure of plant pathogens through a process similar to surface sterilization when comparing to UV-A and UV-B. Short ultraviolet-C treatments have a suppressive effect on phytopathogenic fungi, whereas the plant remains healthy. Since the early 1960s, the effects of monochromatic light on many fungi have been extensively studied *in vitro* and *in vivo*. Numerous reviews have acknowledged these responses. UV-C radiation is known to have a direct effect on various stages of phytopathogenic fungi development, such as germ tube extension and spore germination, hyphal development and sporulation. High spore mortality and inhibited germination of conidia in response to ultraviolet radiation have been observed in several fungal species such as *Venturia inaequalis*, *Sclerotinia sclerotiorum* and *Septoria tritici*. Dry mass production and mycelial radial growth of *Alternaria solani* were decreased upon exposure to moderate doses of UV. Moreover, the effect of application of UV-C to decrease the impact of phytopathogenic fungi is already tested with success on greens golf, potatoes, onions, tomatoes, cucumbers, apple, green peppers, lavender, strawberry, etc. and for the control of postharvest disease. UV-C application seemed to improve the post-harvest lifetime of strawberries and tomatoes by decreasing the infestation of *Botrytis* spp. Furthermore, in greenhouse experiments to control Botrytis stem rot, the use of UV-C radiation diminished the number of Botrytis spots on the strawberry stem. Exposure of cucumber to UV-B radiation suppressed *Podosphaera xanthii* which causes cucumber powdery mildew. Several experiments revealed that UV-C could be a promising technique to control many airborne phytopathogens under field and greenhouse conditions. However, field trials are still needed to confirm our observations. The effect was less significant when UV-A was administered in combination with UV-B. UV radiation effects are detected firstly on the phytopathogens, rather than on induced plant resistance. While, the exposure of plants to UV-A can increase the survival of phytopathogenic fungi. UV-C is therefore most effective if no UV-A is present in the radiation source used, and a period of subsequent red light or darkness is included. Thus, the infection pressure of plants by phytopathogenic fungi was decreased after UV-C treatment in laboratory conditions. Modification of UV-B radiation in the plant environment spectrum is perhaps the most promising application in the future to alter plant- phytopathogenic fungi interactions. It can thus be concluded that UV-A is mostly neutral or even beneficial for phytopathogenic fungi, including the plants colonization by these pathogens, for DNA repair and the processes associated with an efficient infection. On the other hand, exposure to ultraviolet-B and ultraviolet-C leads to harmful effects, often resulting in the death of the phytopathogenic fungi and therefore interesting for an application in horticulture, provided that the plant or beneficial organisms are less damaged by ultraviolet than its pathogen. In addition to these adverse effects on phytopathogenic fungi, the regulation of specialized metabolites in plants and phytopathogenic fungi can affect plant-microbe interactions in various ways. The list of advantages should be weighed against the disadvantages of using different ultraviolet treatments under greenhouse and field conditions depending on a species and purpose-specific basis of plants and phytopathogenic fungi [1-7].

The production of UV absorbing compounds (flavonoids and other phenolics compounds) is the most important adaptation mechanism of plants to UV. Long-term adaptation to improved UV radiation resulted in phenolic levels similar to plants grown under ambient conditions. Responses were established to be clone-specific. These compounds are localized mainly in the epidermis and mesophyll and often function also as phytoalexins or antifungal compounds. Some of the UV-induced responses are believed to augment plant resistance to fungal diseases. Ultraviolet radiation causes the accumulation of pathogenesis-related proteins in the leaves of several species. Flavonoids are often linked with cultivar-specific resistance to fungal diseases, either as a component molecule or as one induced by fungal challenge. Some carotenoids and anthocyanins show similar responses. Epicuticular wax composition and cuticle thickness can affect plant susceptibility to fungal attack. It can therefore be predicted that improved UV radiation should confer greater disease resistance to plants, and in some cases this seems to be a valid assumption. There are few studies on the effects of UV-C light on systemic acquired resistance but treatment of tobacco leaves with UV-C light stimulated the accumulation of salicylic acid. Treatment with UV-C light for 60 s or of 1 s can stimulate plant defenses against biotic and abiotic stresses. Consequently, future studies should test whether the stimulating effect on plant defenses of UV-C light flashes implies the pathway of salicylic acid. If systemic acquired resistance and salicylic acid are shown to play a major role in the immunity conferred by UV-C radiation to plants, then long-term effects would be expected, which could be an incentive to investigate the increasing possibility the time between treatments [5-7].

In conclusion, so far, promising results have been obtained with the use of UV-C radiation in the control of phytopathogenic fungi in fields and greenhouses. We must certainly pay more attention to UV-C light in the future considering that there is increasing evidence for the role those epigenetic mechanisms play in controlling plant immunity. However, further investigation is still required.

Bibliography

1. Aarrouf J and Urban L. “Flashes of UVC light: An innovative method for stimulating plant defences”. *PLoS ONE* 15.7 (2020): e0235918.

2. Loconsole D and Santamaria P. “UV Lighting in horticulture: A sustainable tool for improving production quality and food safety”. *Horticulturae* 7.9 (2021): 1-13.

3. Meyer P., *et al.* “UV-B light and its application potential to reduce disease and pest incidence in crops”. *Horticulture Research* 8.194 (2021): 1-20.

4. Michael R and Yehezkel A. “UV radiation effects on pathogens and insect pests of greenhouse-grown crops”. *Photochemistry and Photobiology* 79.3 (2004): 219-226.

5. Scarlett K., *et al.* "Efficacy of chlorine, chlorine dioxide and ultraviolet radiation as disinfectants against plant pathogens in irrigation water". *European Journal of Plant Pathology* 145 (2016): 27-38.

6. Vanhaelewyn L., *et al.* "Ultraviolet radiation from a plant perspective: The plant-microorganism context". *Frontiers in Plant Science* 11 (2020): 597642.

7. Vega K., *et al.* "UV-C radiation for control of gray mold disease in postharvest cut roses". *Journal of Plant Protection Research* 60.4 (2020): 351-361.