Chapter 1

# Introductory Chapter: Physical Methods for Stimulating Plant Growth and Development

Mohamed A. El-Esawi

Additional information is available at the end of the chapter

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## 1. Introduction

Various physiological, biochemical, and molecular genetic markers have been applied to enhance plant performance and crop yield [1–19]. The required increase of agricultural production has imposed the essentiality for probing incipient and secured decisions due to the incremented requisite of environmental agricultural products and raw materials, which are both used in food and industrial purposes [20]. The substantial alterations of the atmosphere, soil, or even water which all happen due to the excess utilization of divergent chemical supplements used to increment the yield level are some of the most recent results of anthropogenic adjustments that consequently have led to probing these new alternative methods [20]. Such ways for incrementing the products contain the plausible utilization of supersessions or chemicals through using congruous or applicable physical influences or factors [20]. These influences when used on some biologically controlled comportment are considered as a contemporary trend in amalgamating the consolidation of plant technology with the environmental requisites [20]. Physical methods represent alternative promising sources for stimulating plant development and increasing vegetable production. Many physical factors are currently used for plant treatment, including electromagnetic waves, optical emission, laser, magnetic field, gamma rays, and the ultrasound and ionizing radiation [20]. The sensitivity of plants to the effect of these physical factors has been demonstrated.

Various studies demonstrated that the effect of the magnetic field on the seeds enhances their expeditious growth, root growth, and activated protein formation [20–25]. The results of those studies revealed that the treatment of seeds with the magnetic fields incremented nonstandard seed germination and quality. The rationale behind these reactions can be detected in some of the characteristics of green plastids, namely chloroplasts, which represent the photosynthesis apparatus of higher plants.

Several studies recently showed that the treatment by utilizing the ultrasound radiations can transform the conditions of some substances and hence expedite the interactions between them [20]. Such facts have incentivized their implementation to stimulate the development of various cultures [26, 27]. Effects of 22 kHz frequency and 150 W power ultrasound treatments on germination energy and the seed of carrot (*Daucus carota* L.) showed that the superior influences were verified to be 5 minutes only [20]. Seeds of *Robinia pseudoacacia*, *Caragana arborescens*, *Laburnum anagyroides*, and *Gleditsia triacanthos* treated with ultrasound radiation have revealed increases in the germinations of the seeds, shoot length, and fresh weights [20]. It can be inferred that ultrasound treatment has played the vital role of the factors stimulating plant growth. Ionizing radiation effect on plant growth has also studied [28].

## 2. Importance of application of physical methods on plant growth

Chemical additives used for increasing plant productivity cause the contamination of raw materials required for food production [20]. Physical methods are applied for enhancing crop yield and plant growth and development. These methods include the plant treatment with electromagnetic waves, particularly optical emission, ultrasound and ionizing radiation, and magnetic field [20]. Using physical methods for stimulating plant growth has recently increased [21, 22, 29–32]. Additionally, further studies demonstrated that the development of the living organisms is recognized by the effect on physical factors, such as magnetic field, electromagnetic spectrum, and gamma rays [20, 27]. Those factors define the environment for plant growth. Upon physical treatment, the energy in cells is involved in facilitating molecular transformations; therefore, the cells are provided with the required substances [20]. This work discusses the physical methods and properties for stimulation of plant development and seed invigoration. Current research trends, future research directions, and challenges are also discussed.

## Author details

Mohamed A. El-Esawi[1,2]

*Address all correspondence to: mohamed.elesawi@science.tanta.edu.eg

1 Botany Department, Faculty of Science, Tanta University, Tanta, Egypt

2 The Sainsbury Laboratory, University of Cambridge, Cambridge, United Kingdom

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