Design and evaluation of an automatic control system for hydroponics cultivation of mint

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Hydroponics is emerging as a beneficial technique to augment food production in which the quality and yield of a crop are improved by accurately maintaining the desired electrical conductivity (EC), pH and dissolved oxygen (DO) in the nutrient solution. This article describes the development of an automatic control system for mint cultivation in hydroponics that consists of EC, pH, and DO sensors which continuously monitor the respective parameters and control their value in nutrient solution with the help of microcontroller and actuators. The developed system maintained the EC, pH and DO of the nutrient solution within their desired limits of 2.0–2.5 dS m^{-1}, 6.0–6.5 and above 8 ppm respectively. The plant height, average leaf area per plant and total chlorophyll content of the mint plants varied between 18.9–20.3 cm, 15.69–18.45 cm^2 and 23–30 (SPAD units) respectively. The results of this study emphasize the system's effectiveness in monitoring and controlling the parameters of the nutrient solution thereby maintaining favourable growth conditions in the hydroponic cultivation of mint.

Keywords: Automatic control system, hydroponics, nutrient solution, sensors.

large land requirements, elevated levels of chemical inputs, excessive concentrations of nutrients in the soil, use of pesticides, growth of weeds, unavailability of labour on time and decrease in soil fertility throughout time[2]. Hydroponics can overcome all these limitations. With the fast-paced growing population, water consistently gets scarcer, making hydroponics a worthy choice for crop production. It is a technique in which plants are grown in a nutrient solution. To provide support to the plant, various inert mediums like gravel, vermiculite, rock wool, peat moss, sawdust, coir dust, coconut fibre, etc. are used[3]. Hydroponics farming provides many benefits that promote its use in conjunction with conventional agriculture[4]. Since hydroponics cultivation is done in a controlled atmosphere, crops in the hydroponics system are not influenced by climate change. Therefore, crops in this technique are cultivated round the year and considered off-season[5].

In hydroponics, the critical factors that influence production are pH, the electrical conductivity (EC) of a nutrient solution, the concentration of dissolved oxygen, light intensity, temperature, photoperiod and air humidity[6]. Care is required not to allow nutrient concentrations either to become too high or too depleted and pH to deviate from