Organic LED Farming for Self Sustainability During Post COVID-19

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Abstract. An organic LED (Light emitting diode) farming using artificial intelligence is the way to increase crop production effectively with LED lights. Users can able to select specific range of wavelength to induce targeted photomorphogenic, bio chemical, or physiological plant responses. LED can prevent physiological disorder that are commonly existing in indoor environments, and helps in reducing if pest and diseases pressure in growing plants.

Keywords. Light Emitting Diode, Artificial Intelligence, Organic farms

1. Introduction
On 11 March 2020, WHO proclaimed Novel Corona infection Disease (COVID-19) flare-up as a pandemic and emphasized the call for nations to make quick moves and scale up reaction to treat, distinguish and lessen transmission to save individuals' lives. Chennai's (Tamilnadu state capital) well known discount market at Koyambedu has transformed into a COVID-19 area of interest. Cases connected to this market have been consistently expanding, with the contamination discreetly spreading to less-influenced locale of Tamil Nadu. Some random day, the market would see at any rate one lakh guests. Along these lines congestion and blockage was a typical sight at the Koyambedu market. In front of the Tamil New Year on April 14, the market saw a substantial surge. From there on, the circumstance continued as individuals depended on alarm purchasing. During this, there was an insufficient respect for physical separating. Endeavors were taken to close a few pieces of the market and confine the groups. Be that as it may, the infection had effectively spread leaving the market helpful for transmission. During the lockdown, workers from the market needed more work and advanced back home. It is seen that endurance during this pandemic period a major test for the individuals.

2. Organic LED Farming
Fatemeh Kalantari(et.al,) [1] proposed on account of confined admittance to agrarian land, there is a need to keep up cultivating assignments to make ready for food should be added. A few elements influence the food business and handling, for example, populace development and correspondingly expanding needs, decrease of regular sources because of Growing towns, [2] debasement of the earth, different wellsprings of contamination, the presentation of biofuels, limitations. By growing plants
using LEDs, crop production powered by LED lights can be placed next to customers in large cities, reducing the effect of food transport along the chain in this way. In addition, water and nutrients can be saved, the atmosphere and light conditions can be improved and labour can be reduced by producing in vertical farming systems [3].

2.1. Different kinds of lights for plant growth

2.1.1. Fluorescent bulb Fluorescent lights do not last as long as LEDs, but can be identified and mounted quickly. Whether you use them vs. LEDs depends on the indoor light requirements that your unique crop or plant requires [4]. Fluorescent lights were once the source of plant lamps for "go to". They fall out of favour because they are fragile, voluminous, and do not have a high intensity of lumen because they do not last very long. Thus, bulbs for fruiting and flowering plants are not suitable. However, new fluorescents have improved the output of the lumen, come in lightweight bulbs and last longer than their predecessors.

2.1.2. Halogen light Halogen lights additionally give full-range light and are powerful, yet since they radiate a great deal of warmth and are not as energy effective as fluorescent lights, HID lights or LED lights, they are like glowing bulbs [5]. Halogen bulbs are a little more expensive than incandescent bulbs, and a low voltage transformer is often needed. Compared to CFLs and LED lamps, they are currently considered inexpensive. The only issue with halogen bulbs is that they emit a LOT of heat. Sitting under halogen bulbs in a kitchen, work space or elevator can be quite an unpleasant experience.

2.1.3. Incandescent Light Since so much of the energy is converted to heat in incandescent lamps, much of the light intensity is lost. They cannot be positioned close to the plants because the bulbs are hot, even though doing so could increase the light intensity required by the plant. Bulbs should not be mounted closer than 24 inches from the plant to prevent harm to the plants. Compared to the amount of energy required to illuminate the lamp, the amount of light expended is little. The energy that is not used to produce light is emitted as heat. While the initial expense for purchasing incandescent bulbs may be small, relative to fluorescent bulbs, they are much more costly to maintain, while fluorescent bulbs cost more to buy initially [6].

2.1.4. LED The new innovation available today is given by LED Grow Lights [6]. They are profoundly energy effective, have a super low yield of warmth and give an ideal scope of light range. Driven lights are the most impressive, dependable, and client agreeable approach to develop plants at home than developing with bright lights or radiant lights, offering low energy utilization, low warmth, and shading advanced for development.

| Table 1. Spectral Light Treatment |
|-----------------------------------|
| **Lumens** | **Standard** | **Halogen** | **CFL** | **LED** |
| 450 | 40 W | 9 W | 9 W | 8 W |
| 800 | 60 W | 14 W | 14 W | 13 W |
| 1100 | 75 W | 19 W | 19 W | 17 W |
| 1600 | 100 W | 23 W | 23 W | 20 W |
| LIFE | 1 year | 1-3 years | 6-10 years | 15-25 years |
2.1.5. *The main reason behind the selection of LED lights*

- It reduces the risk of combustion
- Made up of epoxy lenses, not glass and so not easily breakable
- It shows that it has longer lifespan

It should be noted that simply a large portion of the temperature of a halogen or brilliant bulb of comparable splendor is the most sweltering piece of a LED. They are about 19.5% (approximately) cooler than CLF lights, also. The explanation behind this is that a warmth sink, situated at the base of the bulb, which draws the greater part of the warmth to one spot, utilizes LED innovation and keeps the gadgets generally cool. Also, one reason LED's have long life expectancies is to keep the bulb cool. The other explanation is just that, through heat, a LED doesn't squander its energy and its main part is utilized to supply light. Warmth is created by LED's, yet it is inside held. Customary lights and CFL lights lose somewhere in the range of 60% and 95% of their warmth input power. The innovation that drives LED's (light transmitting diodes) is alluded to as SSL or strong state lighting. This suggests that light isn't transmitted from a vacuum (similar to the case with brilliant lights) or from a gas (like CFL lights), however a semiconductor from something strong. Driven bulbs are current-driven gadgets, and best practices direct that they ought to consistently be connected in arrangement, and never in equal, with a resistor. They become more conductive as LED's warm up and, in the event that they are connected in equal, you risk harming them by over-burdening the current.

2.2. *Theory Background*

Recent researches state that plant use some wavelength light for photosynthesis. In Yorkshire, a research centre absorbed how plants grow without green light. Recent study states that plants don’t use the green light wavelength because they reflect the green spectrum [7]. It is interesting to absorb that plant use red and blue light for photosynthesis. But the absorption of light varies in different plants [8,9].

**Question:** How LED lights are differentiated of their wavelength [10]?

*Violet* blue light typically comes in the range of 400 and 500. This encourages the early stage of photosynthesis. They veg and flower plants well. Green light in the range of 500 to 620 is ideal for plants with thick growth cover, as it can penetrate foliage for better light retention. It is proved that green LED light has some powerful antibacterial property which helps in growth [11]. Red light in the 600 to 730 range promotes flowering for later stage plants. It is responsible for making plants flower and produce fruits. It is even responsible for seed germination, root growth and bulb development [12].

2.3. *Literature review*

As announced by (Mitchell and stutter), there is no single recipe of light quality that suits all species and every stage of growth in plants. A compromise between red and blue LEDs will normally, however push photosynthesis and control of most plant’s vegetative growth. Technical development in LED technology has increased the production, electrical efficiency and availability of horticulture wavelengths allowing for an increase in research and commercial growth. Many companies are developing horticulture multi wavelength LED fixtures. In addition to the ability to control and the spectral quality of light in which the plants are produced. The general light quality and the coolness of LED light emanating surfaces empowers them to be near one another. Squander heat is separated from the genuine diode distantly for plant tissues. LEDs are situated to turn into the light source with the most elevated electrical energy transformation proportion with developing innovation progresses. Indeed, even now, selectable, multicolour LED clusters and discrete producers are monetarily accessible and moderately modest. While many LED gadgets don't can create sufficient light levels for sole-source crop lighting, a couple of frameworks do, this number will increment. Less exceptional...
sources could likewise be utilized in green houses for extra enlightenment with chose frequencies or for night breaks for taxing day crops in slow time of year creation.

As indicated by Celina Gomez, LEDs are ideal candidates for single-source photosynthetic lighting in VFs, as fixtures usually have a low power density per unit growth area (kW·m⁻²) and can provide high light intensities with low radiant heat transmitted to crops. Initial effort to grow high-value crops using water-cooled HPS lamps in warehouse-based plant factories; However, economic viability was negated by the high energy consumption needed to manufacture HPS lamps; follow-up studies used fluorescent lamps, which became common in regulated environments. LEDs are now commonly used in VFs in Asia, however, and are gaining popularity in other nations where commercial VFs grow a range of leafy greens, young plants, and low-professional plants. Akiyama and Kozai defined that the impact of the LED fixture design (lamp and plant spacing) on the spatial distribution of PPF in simulated VF. LEDs can be used to monitor the path of light and reduce the gap in between lamps and plants, depending on the canopy structure, thereby optimizing the efficiency of light-use. LEDs' solid-state electronics ensure protection and inexpensive techniques for risk management that are highly relevant in manned space missions. In several studies, the impact of the space-flight environment on plant growth has been highlighted, suggesting that there is a crucial need for research to support the objective of providing effective for rural communities which used to rely solely on fuel-based lighting, improvements in robustness and cost reduction of LEDs have made access to electric lighting a reality. In combination with photovoltaics, the low-energy requirements of LEDs have led to the development of solar-powered LED systems that can offer significant opportunities for off-grid agricultural applications.

Dr. E. sahaya ugin mary, Common acceptance of organic agriculture System by extension to agriculture Program. It is important to make farmers Conscious of components that communicate and their components Linkages within the framework of organic farming. Farmers should be made aware of the relationship between Components and their organic connectivity Agricultural framework through the conduct of special systems Software for preparation, Management Decisions not only should environmental and environmental concerns be represented, broad social considerations, but also broad social factors individual ambitions and lifestyle choices. Adoption of such technology or activities, Profitability may also involve that guarantee. Management is so intensive that one's lifestyle actually worsens. Leadership Sustainability-promoting options nourish sustainability climate, society, and the individual. Protecting soil from organic cultivation Erosion, loss of nutrients, and Organic agriculture, the systemic failure, is Based on ecological notions. It makes use of Appropriate applications and appropriate Modern methods of farming.

According to the authors perspective opinions are varied the main objective of Mitchell and stutte is to control and the spectral quality of light in which the plants are produced and to develop a relatable multi-colour LEDs according to the plants. Also Dr. E. sahaya ugin mary says that not to depend on farmers traditional way of agriculture because depending on climatic conditions leads to limited cultivation according to the respective season. Celina Gomez says providing effective for rural communities which used to rely solely on fuel-based lighting, improvements in robustness and cost reduction of LEDs have made access to electric lighting a reality.

3. Methodology

3.1. Experimentation setup
In this examination, LED lights utilized for developing are set straightforwardly finished or just to the side of plants as they sprout. The client controls the light sort, on/off and the shade of the light dependent on the development phase of the plant [13]. The seeds were planted in business base and developed in naturally directed development chambers. The seedlings were haphazardly treated using blue (455-475 nm; B) red (650-670 nm; R) after germination. The field utilize around 98% less water and no pesticides and there is no need of anything to the plant the water and supplements go into the root framework nothing's at any point contacts those leaves so is turns into a synthetic free. The
ghastly of light medicines and frequency are summed up in Table 2. These developing lights are explicitly intended to supplant regular daylight, advance photosynthesis and give the right range of shading where the plant can develop and prosper [14].

Table 2. The spectral of light treatments and wavelength

| S.NO | LED Colour | Wavelengths (nm) |
|------|------------|------------------|
| 1    | Red        | 630-750          |
| 2    | Orange     | 590-630          |
| 3    | Yellow     | 570-590          |
| 4    | Green      | 490-570          |
| 5    | Blue       | 450-490          |
| 6    | Indigo     | 420-450          |
| 7    | Violet     | 380-420          |

4. Overall Outcomes

Man-made consciousness went about as the primary driver of arising innovations like huge information, advanced mechanics and IoT. It impacting the future of agriculture industry virtually in many ways [15,16]. Especially, it helps stakeholders to improve harvest quality and accuracy using precision agriculture.

It leverages to help by identifying whether the plants get affected with any diseases and it grows healthy and has high nutrition and pests. One way to achieve to increase the yield of production from existing farmland is by using LED lights for plant growth [17].

Now-a-days these procedures give a few chances to screen the plant development and improvement from beginning and to the consummation of the gather. In past years, the agribusiness was brimming with manual escalated in the current age ranchers, there are different advances which can be utilized to diminish the manual work, serious errand [18].

By comparing the plant grown in land and using LED. The rate of plant growth is comparatively higher than plant grown in land.

Due to this “Pandemic covid-19” situation, the lockdown further reduces economic growth and demand for agricultural products, dislocation of labor force and distribution of supply chains. [19,20]. These results make us to identify the need of beverages to human beings.

There are many advantages when compared to traditional methods. By using LED for plant growth, the rate of growth is greater than in traditional methods. There are ever changing and quickly changing world in the nearly 30 years somewhere between 9 and 10 billion people on the planet so an enormous amount of pocket and at the same time we need 50 to 70% more food to feed [21].

It gives us a ridiculous time where to field how to field. This paves a solution for enormous amount of food born illness. That exactly develop a building of indoor farming can be done at scale [22,23]. In this case we can also grow the purest and the best. It can actually grow more than twice as fast as the field per crop in the year.

The precision agriculture has high effective and it is good step forward for the system. Without the involvement of manual power, analysis the changes of environment and changes get pushed out automatically and stored in the system. To implement further, it has an ability to control the temperature, humidity and lighting sense of LED [24,25].

A small kind of issues on the tip of our leaves can be and these issues changes on the next time to grow this kind of crop and doesn't repeat these problems because this is a multi-armed hand problem. The problem is the effort to feed large and had a healthy life.
5. Interface
The experimental setup is shown in figure 1, 2 & 3 the seeds were sowed and the plant growth and disease is monitored and detected using deep learning at each day.

![Figure 1. Day 1 Seed Sowing](image1)

![Figure 2. Day 3 growth](image2)

![Figure 3. Day 11 growth](image3)
6. Impact of AI - Future scope

For methods such as precision agriculture, farmers use AI; they can monitor crop humidity, soil composition, and temperature in growing areas, allowing farmers to increase their yields by learning how to take care of their crops and determining the ideal amount of water or fertilizer to be used. The business has been roused by variables, for example, environmental change, population development and food security issues to investigate more innovative ways to deal with safeguarding and improving harvest yield. Therefore, AI is ceaselessly developing as a feature of the mechanical advancement of the market. As climate change continues to be researched and analysed, crop and soil monitoring technologies will also be important applications in the future. It will be critical for farmers to be equipped with up-to-date training to ensure that the technology is used and continues to develop. This will help to prove the worth over the long haul of these instruments.

7. Conclusions

Organic LED farming leads to protective environment. The effect made on organic LED farming has been studied. It is observed that depending on traditional agriculture may not be possible on future hence organic LED farming and due to practice of this method people can cultivate their own food leads to sustaining biodiversity. According to the technology implementation of Artificial Intelligence by monitoring disease an nutrients level that could be done in future.

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References

[1] Kalantari, Fatemeh, Mohd T, Osman & Akbari J, (2017). Opportunities and Challenges in Sustainability of Vertical Farming: A Review. Journal of Landscape Ecology. 11. 10.1515/jlecol-2017-0016.

[2] Deressai T T and Ingleri C R Environment and Production Technology Division, International Food Policy Research Institute, 2033 K Street, N.W., Washington, DC 20006-1002, U.S.A. 2 Centre for Environmental Economics and Policy in Africa (CEEP), Department of Agricultural Economics, Faculty of Natural and Agricultural Sciences, University of Pretoria, Pretoria, South Africa Revised MS received 4 May 2010; Accepted 5 May 2010; First published online 23 August 2010.

[3] Jensen and Merle (2002-06-01). "Controlled environment agriculture in deserts, tropics and temperate regions- A world review". Acta Horticulturae. 578 (578): 19–25. doi:10.17660/ActaHortic.2002.578.1

[4] Pfündel E, Baake E, A quantitative description of fluorescence excitation spectra in intact bean leaves greened under intermittent light. Photosynth Res 26, 19-28 (1990). https://doi.org/10.1007/BF00048973

[5] Ichia Y and Jen-Ping C, High-brightness LEDs—Energy efficient lighting sources and their potential in indoor plant cultivation, Renewable and Sustainable Energy Reviews, Volume 13, Issue 8, 2009, 2175-2180, ISSN 1364-0321 https://doi.org/10.1016/j.rser.2009.01.027

[6] Agrawal, Dull, Leff, Harvey & Menona V (1996), Efficiency and efficacy of incandescent lamps. American Journal of Physics - AMER J PHYS. 64. 649-654. 10.1119/1.18260.

[7] Pocock and Tessa (September 2015). "Light-emitting Diodes and the Modulation of Specialty Crops: Light Sensing and Signaling Networks in Plants". HortScience. 50 (9): 1281–1284. doi:10.21273/HORTSCI.50.9.1281. ISSN 0018-5345.

[8] Plant Growth Factors: Light Archived 2013-12-04 at the Wayback Machine

[9] Massa, Gioia D, Kim, Hyeon H, Wheeler, Raymond M, Mitchell and Cary A. (2008-12-01). "Plant Productivity in Response to LED Lighting". HortScience. 43 (7): 1951–1956. doi:10.21273/HORTSCI.43.7.1951. ISSN 0018-5345.
[10] Are LED Grow Lights Really That Efficient?”. Feedtheseeds. 2019-02-22.

[11] Fan, X., Yang, H. and Y. He, "Prototype Design of Variety Discriminator of Farm Products Based on Multi-color LEDs and BP-ANN," 2009 WRI World Congress on Computer Science and Information Engineering, Los Angeles, CA, 2009, pp. 76-79, doi: 10.1109/CSIE.2009.787.

[12] Harun A N, Ahmad R and Mohamed N, "Plant growth optimization using variable intensity and Far Red LED treatment in indoor farming," 2015 International Conference on Smart Sensors and Application (ICSSA), Kuala Lumpur, 2015, pp. 92-97, doi: 10.1109/ICSSA.2015.7322517.

[13] Yang, L.Y., Wang, L.T., Ma, J.H. et al. Effects of light quality on growth and development and photosynthetic characteristics of plants. Photosynthetica 55, 467–477 (2017). https://doi.org/10.1007/s11099-016-0668-x

[14] Kim, Hyeon H, Wheeler, Raymond M, Sager, John C, Yorio, Neil C, Goins and Gregory D. (2005-01-01). "Light-emitting diodes as an illumination source for plants: a review of research at Kennedy Space Center". Habitation. 10 (2): 71–78. doi:10.3727/154296605774791232. ISSN 1542-9660. PMID 15751143

[15] King and Anthony. (2017). Technology: The Future of Agriculture. Nature. 544. S21-S23. 10.1038/544S21a.

[16] Bhandari H and Mishra A K. Impact of demographic transformation on future rice farming in Asia. Outlook on Agriculture. 2018;47(2):125-132. doi:10.1177/0030727018769676

[17] Duguleană L, Bălăşescu M, Duguleană C, Bălăşescu S, Neacşu NA and Dovleac L. Dynamic analysis of European organic agricultural areas in the context of sustainable development. Outlook on Agriculture. 2018;47(1):27-35. doi:10.1177/0030727018761689

[18] Rahman S and Thapa GB. Environmental Impacts of Technological Change in Bangladesh Agriculture: Farmers’ Perceptions and Empirical Evidence. Outlook on Agriculture. 1999;28(4):233-238. doi:10.1177/003072709902800406

[19] Baudron F and Liégeois F, Fixing our global agricultural system to prevent the next COVID-19. Outlook on Agriculture. 2020;49(2):111-118. doi:10.1177/0030727020931122

[20] Di Vaio A, Boccia F, Landriani L, Palladino R, Artificial Intelligence in the Agri-Food System: Rethinking Sustainable Business Models in the COVID-19 Scenario. Sustainability 2020, 12, 4851.

[21] Saiz R V and Rovira M F, From Smart Farming towards Agriculture 5.0: A Review on Crop Data Management. Agronomy 2020, 10, 207.

[22] Roach J, (June 30, 2009). "High-Rise Farms: The Future of Food?". National Geographic News

[23] Kalantari, Fatemeh, Mohd T, Osman, Mahmoudi L, Ahmad, Kalantari, and Shahaboddin. (2017). A Review of Vertical Farming Technology: A Guide for Implementation of Building Integrated Agriculture in Cities. Advanced Engineering Forum. 24. 76-91. 10.4028/www.scientific.net/AEF.24.76.

[24] Bian, Zhonghua, Jiang N, Grundy, Steven, Lu and Chungui. (2018). Uncovering LED light effects on plant growth: New angles and perspectives – LED light for improving plant growth, nutrition and energy-use efficiency. Acta Horticulturae. 1227. 491-498. 10.17660/ActaHortic.2018.1227.62.

[25] Gnauer C, Pichler H, Tauber and M. et al. Towards a secure and self-adapting smart indoor farming framework. Elektrotech. Inftech. 136, 341–344 (2019). https://doi.org/10.1007/s00502-019-00745-0