

Automation in Indoor Horticulture using Water Cooled Light Emitting Diodes

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Abstract - Agriculture and gardening area unit the vital drive factors of Indian Economy, in today's world, the zoom in world population, gardening becomes additional vital to fulfill the requirements of the humanity. However, agriculture needs irrigation and with each year we've additional water consumption than rain, it becomes crucial for growers to seek out ways in which to conserve water whereas still achieving the very best yield. However, within the gift era, the farmers are victimizations irrigation technique through the manual management within which they irrigate the land at the regular interval. in step with statistics, agriculture or gardening uses eighty fifth of obtainable fresh resources worldwide, and this proportion can still be dominant in water consumption thanks to increment and inflated food demand. there's associate pressing got to produce methods supported science and technology for property use of water, together with technical, agronomic, social control and institutional enhancements. Agricultural irrigation supported net technology relies on crop water demand rules. By victimization net technology and sensing element network technology we can management water wastage and to maximize the scientific technologies in irrigation strategies. Then it will greatly improve the employment of water and might increase water productivity farms.

Keywords: Agriculture, Automation, Smart horticulture, LEDs based indoor agriculture.

I. INTRODUCTION

In this research paper we carried out the impact analysis of automation of indoor horticulture system by water cooled Light Emitting Diodes (LEDs). We did experimental based study analysis for finding the results of this system. Within the case of ancient greenhouses, water cooled semiconductor diode grow lights can have terribly tiny shadow footprint permitting additional daylight penetrate the greenhouse, therefore additional natural daylight is accessible for the plants. Water with efficiency transfers heat from LEDs to the place wherever it may be cooled or re-used for heating. This fashion it's a lot of easier to manage temperature on the plant

leaves that could be a crucial parameter for triple-crown growing. Water could be a favorable medium for biological growth, which can additionally deposit on the semiconductor diode grow lightweight water channels and tubes and impair cooling. Chemicals got to be side to water to fight undesirable flora and improve longevity of the sunshine. Bubbles might seem in a very cool system that's designed and created incorrectly, and these bubble might keep within the same spot of the semiconductor diode grow lightweight for a while, therefore reducing cooling.

a) Water Cooled LEDs based indoor automation system working horticulture principle

Before you begin to among the main considerations of agricultural producing incorporates food safety, environmental impact, economical energy usage and temperature change. Towards, provide comeback to the present, the paper highlights the planned automation of indoor farming apply that operated by with dance band of red and blue lightweight emitting diodes (LEDs) as source of illumination for the cultivation of lettuce in easy Nutrient Addition Program based mostly (SNAPB) husbandry system. The projected study attentive on the assessment of 2 investigational arrangements associating the standard SNAPB husbandry to the easy Nutrient Addition Program based mostly husbandry victimisation LEDs lights. At the top of the most experiment, the results counseled that semiconductor diode as source of illumination have a vital impact on the quantity of leaves ($t(41.7) = 6.07, p < (0.05)$ and leaf space ($t(48) = \text{four}.39, p = (0.05)$ of a lettuce. Specifically, the results showed that once the surroundings of the lettuce were controlled, their ability to grow considerably additional and bigger leaves will increase. Also, the load obtained victimisation the SNAP with semiconductor diode lights setup (3.04 kg) was half-hour bigger than the load obtained victimisation typical (2.18 kg) husbandry setup.

II. EXPERIMENTAL BASED STUDY ANALYSIS

A light weighting system for indoor farming for delivering high intensity light whereas reducing or eliminating

heat masses in very growing surroundings is provided. The lighting system comprises a lighting housing having a primary finish, a second finish, a primary facet, a second facet opposite the primary facet, a 3rd facet between the primary facet and also the second facet, and a fourth facet opposite the third facet. A primary semiconductor diode board is mounted to the primary facet and a second semiconductor diode board is mounted to the second facet. A primary shroud covers the primary semiconductor diode board and a second shroud covers the second semiconductor diode board. A fluid passage is made fully through the lighting housing. A fluid liquid is owed through the fluid passage. The fluid liquid provides active cooling, of the lighting housing from heat created by the primary and second semiconductor diode boards.

Cutting of Rose flower piece is one in all the wide fully grown cut flowers in Kenya. Though, most roses have a encounter of speedy jar life. This analysis study geared toward decide the effectiveness of plant cuttings from thyme and stevia in safeguarding of cutting of Rose flower items. 2 rose cut-flower cultivars; 'radiance and 'high & sparkling' were subjected to stevia and thyme extracts every at 3 levels (0.2, 0.4, and 0.6g/L-1)(1). Thyme extracts at a level of zero.2 g/L-1 considerably ($p \leq 0.01$) extended the jar lifetime of Cutting of Rose flower piece by three.5 days and floral absorption rates by ten.4% compared to the industrial preservative (chrysal) at a similar concentration rate. Application of upper doses (0.4g/L-1 and zero.6g/L-1) (2) of plant extracts semiconductor diode to shorter jar life (6 days) of Cutting of Rose flower piece and extreme bent neck records at day eight. The retort of cutting of "Rose flower" piece to the treatments failed to vary between cultivars. The results from this study indicate that thyme extracts provide a sexy different to the employment of chemical floral preservatives for prolonging the jar life and enhancing quality of Cutting of Rose flower piece. The effectiveness of extracts is but relied on the concentration level with zero.2g/L-1 dose recording the most effective results. (3)

A field experiment was dispensed to gauge the result of the appliance of poultry manure and wood ash on the expansion and grain yield of maize (*Zea mays L.*) (4) The poultry manure was applied period of time before planting to permit for correct decomposition. Wood ash was applied every day before planting. There have been 3 treatments all told as well as the management and also the treatments were organized during irregular complete block style (RCBD) with 3 replicates. Plant height ANd leaf space were taken at 3 weeks once planting to 9 weeks once planting with an interval of period of time. We tend to be done experiment with the grain yield for eleven weeks once implanting and was dehydrated, weighed and recorded. The outcomes exhibited

that poultry manure expressively increased plant height of approx. (192.0 cm) and grain yield approx. (4.83 t/ha) however has no significant outcome on the amount of leaves and leaf space with 12cm and 3403.6cm² severally. (5) The values of plant altitude and leaf space of the management were relatively high connected with different treatments. This may be attributed to the supply of N within the soil. The timber residue was originating to convey the bottom standards for N moreover as vegetative growth of maize, this can be commissioned to the detail that N tends to volatilise once in interaction with alkalic mediums and consequently have an effect on vegetative growth of maize.

A pot experiment was dispensed at the scientific agriculture Teaching and analysis Farm of the University of Agriculture Makurdi to see the result of metal fertiliser on the expansion and yield of rice. Treatment consists of 5 levels of metal (Mn) (0, 5, 10, fifteen and twenty weight unit ha⁻¹) in kind of MnSO₄. (6) The treatments were arranged go in a totally irregular style (CRD) with 3 replications. The results of Mn on the event of rice designate that near were no important alteration within the development constraints measured with the exclusion of plant tallness at eight weeks once implanting and range of tillers at four weeks once implanting. The tallest plants and highest range of tillers were obtained with ten weight unit ha⁻¹ Mn. the result of Mn on the harvest of rice designate that there was a stimulating alteration within the yield constraints restrained with the allowance of extent of grains per raceme and root weight at four weeks once implanting. Metal at the speed of ten weight unit ha⁻¹ gave the very best grain yield (2,667 weight unit ha⁻¹) (7) and highest dry matter weight. Levels of Mn higher than ten weight unit ha⁻¹ semiconductor diode to yield decrease, so application of ten weight unit ha⁻¹ Mn was suggested for optimum yield of rice.

A ground analysis study was supported dead set live some assessable variations in organic chemistry properties of the soil of tehsil like GarhiKhairo, district Jacobabad. Nearly Forty-five integrated soil samples were along at sampling pits, 0-15 cm, 15-30 cm, and 30-45 cm from fifteen totally different regions of tehsil GarhiKhairo for comparison study dispensed before and once floods. Samples were analyzed for the determination of varied chemical parameters like hydrogen ion concentration, electrical physical phenomenon, soluble atomic number 11 (Na⁺), atomic number 19 (K⁺), metallic element (Ca⁺²), and metal (Mg⁺²). (8) Results of the analysis were compared with the reference information that were analyzed before the flood. Outcomes of the investigation exposed that thanks to overflow, organic chemistry landscape of soil was altered from slightly alkalic to powerfully alkali within the observative study it had been found that before and once flood

soil leftovers non-saline. There has been a stimulating growth within the best concentration of soluble atomic number 11 (Na⁺), metallic element (Ca⁺²) and metal (Mg⁺²). Though; atomic number 19 (K⁺) happy of the soil was systematically reduced. (9)

Standard development and growth of plant tissues need water, carbon dioxide, nutrients, and light. Light-emitting diodes (LED) are existence used progressively as a supernumerary for fluorescent or luminous light sources in greenhouse cultivation since of their small magnitude, strength, wavelength specificity, long operational life, and effectiveness in contribution photosynthetically vigorous energy radiation at lowered energy costs associated to conventional lights. However, studies conducted to test the effects of these lights reveal that spectral properties of light-emitting diodes can have dramatic effects on plant morphology, nutrient uptake, and pathogen development when plants are grown under the incorrect light spectrums. We have produced sorghum vegetations under a LEDs (light-emitting diodes) produce panel and equated it to plants grown-up under conventional fluorescent lighting within equal ecological chambers. LEDs (Light-emitting diode lighting) occasioned in harmful sorghum evolution with fewer true leaves molded, compact plant height, lower chlorophyll content, and an uncommon pink to purple coloring of the plant tissue once associated to sorghum grown under conventional lighting. The different sorghums grown under light-emitting diodes had 2× the amount of biomass restrained for all the 4, as the different dry weights for upper (stems and leaves) and lower (root mass) when equated to the conventional lighting. When we were crawling sorghums with sugarcane aphid, *Melanaphis sacchari* (Zehntner) (Hemiptera; Aphididae.), both light sources maintained a comparable number of aphids, but plants grown under (LEDs) light-emitting diodes had developed mutilation evaluations than those under conventional lights for both known unaffected and susceptible sorghums. It has been observed that for upcoming experiments, sorghum would not be full-grown by means of the LEDs (light-emitting diodes) lights when measuring host-plant resistance to aphid infestation. (10)

Coleus (*Plectranthus scutellarioides*) is an attractive and well known ornamental plant with propagation mainly achieved through vegetative cuttings. It is useful for commercial purposes to enhance the speed of establishment and simultaneously maintaining high quality. Light quality has been shown to influence adventitious root development therefore these experiments examined the effect of narrow-bandwidth light treatments on root growth and overall plant quality for seven *coleus* cultivars with vegetative cuttings in potting soil and one cultivar with shoot tip in vitro cultures

onto Murashige and Skoog (MS) agar medium. Throughout the retro of 28 days of recording the etchings full-grown under narrow bandwidth red light (R; 663.4 nm at peak) extra than folded in the adventitious root amount equated with those under blue light and green light (B: 445.7 nm.), (G: 530.0 nm.) respectively in five cultivars. Red light also augmented additional weight of the etchings by 55.6% additional than Green light. In evaluation, the etchings grown-up under Green light yielded significant lower root and shoot dehydrated figure than other light handlings. Red light cuttings showed more dry mass content (9.63%) than those under white light (W; 437.4 nm and 559.5nm at peak) and Green light (approx. 7.85% and approx. 5.86%, respectively). (11) A positive correlation ($R^2 = 0.598$, $P < 0.001$) was found between the formation of adventitious roots and gained fresh weight of cuttings. Red light thru the reddish colour of leaves extra robust in most cultivars, although the carvings showing to Green light turn out to be less bright equated with other light circumstances. As soon as the sprout tips were spread in vitro onto MS standard, Red light behavior began the root growth more quickly than additional lights, with a more better foraging rate (20.0% & 63.6%,) respectively at 5 days and 10 days. The sprout tips under Red light also shaped tiredly more roots (12.3% per cutting) than those grown further down narrow-bandwidth Blue light (5.8% per cutting). The sprout tips displayed charring at a premature stage and afresh arose leaves produced very efficiently under Blue light. The grouping of red and green light (Red + Green light) augmented additional than double as abundant roots and dry mass equated with White light. In accumulation, the Red + Green light directed to morphological fluctuations, together with greater leaves and stretched petioles and internodes than those in additional light actions. The acquaintance to combo of Red + Green + Blue light and Blue light finished the shoots very compressed for the 28 days of in vitro culture duration and significantly augmented the chlorophyll fillings consequential in very dark green leaves.

Vegetative cutting is a crucial propagation technique for the mass production of ornamental annuals, perennials, herbs, shrubs, trees, and foliage plants. This method offers considerable advantages of maintaining identical phenotypic traits (colors, volatiles, growth rates, yields, or disease resistances) from selected species or cultivars (Bellini et al., 2014; Daud et al., 2013). Environmental factors such as adequate mist interval, relative humidity, temperature, light, and ambient air flow should be carefully considered for the stable formation of adventitious roots, which is essentially required to produce healthy, independent plants (Christiaens et al., 2015). The expansion of adventitious origins also has been shown to be auxin facilitated and light reliant on. All the Lights performances provocatively with endogenous auxin-

indole-03 acetic acids) actions in plant tissue, which excites the adventitious root growth. The auxin shaped in sprout top basipetally passages dejected the plant stems and collects at the base of carvings to pledge adventitious roots. Thought of light superiority by vegetations can inspire variations in gene appearance and hormonal constraint subsequent in morphological expansions (Pedmale.). It has been observed that the plants apprehension the wavelength consequently flying (380–750 nm) to adapt light energy into chemical energy (photosynthesis) and as ecological signals to switch specific patterns (photomorphogenesis). This occurs through the activation of a discrete set of photoreceptors—the phytochromes, cryptochromes, phototropins, and other light-oxygen-voltage domain proteins and UV RESISTANCE LOCUS 8—which detect and respond to changes in quality, quantity, and the photoperiod of light (Batista et al., 2018; Huche-Thelier et al., 2016; Moni et al., 2015; Pedmale et al., 2016). Red light (650–660nm) has been reported to enhance adventitious root formation in grapes and *Protea cyanides*. In *Arabidopsis*, phytochrome A and B (PHY A and PHY B) mediate the positive phototropic responses to red light, and these two photoreceptors are involved in the modification of local endogenous auxin levels. As we observed that blue light impacting sometimes unpredictable on rooting and in under blue light (460 nm) in 2 weeks, Eom experiential actual quick root creation from sweet basil stem cuttings. Though, super optimistic blue light self-conscious root creation in strawberry plantlets. (12)In the blue light it has been observed that the root growth was reduced in grape in vitro culture. Light-Emitting diodes (LEDs) variety it likely to syndicate dissimilar wavelengths thus that the modified combination of lights can encourage additional needed development features for species and cultivars.

Improvement of rooting, leaf color changeover, and superior seedling evolution might be accomplished with optimal procedure of wavelength (Daud et .2013.; Fan et. 2013.a; Kim., 2004a.; Olschowski et 2016.; Wollaeger, and Runkle, .2014.). *Coleus* (*Plectranthusscutellarioides*) is an appreciated ornamental plant because of its significant genetic variability. Because its propagation is attained by rooting vegetative cuttings, it was of interest to test the hypothesis that narrow-bandwidth light conditions could improve the rooting efficiency over standard white light conditions. Seven commercial *coleus* cultivars were cutting-propagated in soil under five different wavelength treatments. Also, *coleus* shoot tips from one cultivar were rooted onto MS medium in vitro under various light treatments including single or mixed wavebands, compared with cool-white fluorescent (CWF) treatment. It was shown that different narrow-bandwidth light treatments influenced adventitious rooting, shoot growth, and leaf color transition of *coleus* plants grown from vegetative

stem cuttings, as well as establishment of in vitro shoot tip cultures. These experimental results demonstrate that propagation of *coleus* may be hastened by application of narrow bandwidth.

This article explains the method of increasing the germination and speed of seed development by using the optimal ratio of spectral components of intensity and photoperiod required for the seeds of vegetable and green cultures at the germination stage. The technique is created on the estimate of the partial spectra of isolated sources of radiance to a constant adapted spectrum of sunlight by the technique of the smallest squares in order to minimize the square of the estimated error. The combination of six dissimilar categories of LEDs (Red, Green, Blue & White (RGB), “full-spectrum” (RGBWFI) and ultraviolet was intervened for the estimate of the incessant spectrum for radish seeds. The trial carried out for a period of three days. Afterward the three days of investigational sprouts, the normal growth rate root length (stimulated by RGBWFI LED) was observed approx. 9.4 mm, the entire length of the germ 24.7 mm, the root thickness was 0.85 mm and the total sprouting was 89.7%. This research is being conducted on various seeds to adequately optimize the method for a specific seed culture.

The found effectivity criteria will provide an opportunity to systematize numerous popular results of the impact of various light modes in order to identify plants as a biological object by optical properties.

It's been determined over past periods; light-weight-Emitting diodes (LEDs) are subbing greatest extra forms of light resources. One developing usage for LEDs in cultivation is ‘intra-canopy illumination’ or ‘LED-inter lighting’, attainable behind to their low heat production and tiny bodily size. within the bury lighting procedure, characteristically performed in ecologically measured greenhouses additionally attended with higher than lighting, is often relevant high-wire flavorer farming, within which self-shading consequences in light-weight limitations for a good portion of the cover. The bury lighting has stayed exposed to encourage the yield or progress fruit excellence in all-year rounded greenhouse yields like cucumber, sweet pepper, tomato. during this effort, we tend to be operated daytime extra intra-canopy LED brightness for sweet pepper fully grown in high price of ‘Spanish’ trellis systems within loath high tunnels within the Israel. Whereas cover high at these conditions isn't light-limited, intensive deep shading of the inner cover may be a disadvantage. In 2 experiments dole out in 2 separate seasons, the supplemental lighting, that increased the chemical action rates of the inner cover foliage by three.5- to 5.7-fold, resulted in significant increase of fruit yield within the spring season

approx. (~30%). The additional yield was accomplished by higher fruit numbers, with no impact on fruit size or weight. Our consequences increase the read that LED-inter lighting can be a valuable real-world tool for take full advantage of fruit production, uniform in terrestrial areas of masses daylight. 2019 - Throughout this study, the intention was to see the foremost adequate carbohydrate (CHO) sources below varied light-emitting diodes (LEDs), and therefore the impact of chlorocholine chloride (CCC), fortheinvitrore generation of the protocom-like bodies (PLBs) in genus *Phalaenopsis* 'Fmk02010'. we have a tendency to applied fifteen LEDs combined with 3 CHO sources and five three hundred concentrations among the study. It's found that Organogenesis of PLBs was terribly disadvantaged in malt sugar each for the amount of PLBs and their new weight (FW) equated to instrumentality encompassing plant product and trehalose. Plant product was the best CHO supply below the red white (RW) LED for the in vitro organogenesis of PLBs (PLBs: fifty-four.13; FW: 0.109 g), tho' trehalose was greatest beneath the blue-white LED (PLBs: thirty-six.33, FW: 0.129 g). The red-blue-white (RBW)-trehalose fusion shaped an appropriate amount of PLBs (35.13) with the utmost FW (0.167 g). CCC at 0.01, 0.1, and 1mgL-1CCC had no effect on PLB creation or FW, however 10mgL-1 reduced each. The addition of low concentrations of three hundred within the plant medium square measure nonessential. 2019 - Utilization of sunshine emitting diode (LED) technology is beginning to replace ancient lighting in greenhouses. During this analysis we have a tendency to absorbed on the impact of LED lighting and gibberellin supplementation on development and planting of *Dahlia pinnata* spp. 'Karma Serena', genus *Liatis spicata* 'Kobold', and *Lilium asiatic* 'Yellow Cocotte'. Light-weight treatments, accustomed extend photoperiod, enclosed LED enclosed lamps and group lamps that emitted a mix of red + far-red + white, red+ white, and broad spectrum from late fall to early spring. gibberellin treatments vary from forty to 340 mg L-1 for Asiatic liliaceous plant 'Yellow Cocotte', fifty to 250 for gay-feather 'Kobold', and fifty to one hundred fifty for *Dahlia pinnata* 'Karma Serena'. Results varied among species in response to lightweight and gibberellin. For gay-feather 'Kobold', enclosed occurred time period earlier below sole LED light-weighting than below different light-weight treatments and no supplemental light. whereas planting happened the initial for place *Dahlia pinnata* 'Karma Serena' below no extra lightweight, vegetations below light-weight exposures had higher height, width, and sprout weight important effects of gibberellin on development and planting measurements.

Monochromatic diode lamps (LEDs), emitting red and blue lights, revolutionized crop producing in closed-system plant factories with artificial lighting within the early Nineteen

Nineties. In 2010 the event of LED engineering offers broad-spectrum white-LEDs and diverse forms of white-LEDs for home and workplace practices square measure currently accessible for plant manufactory business persons. This paper tries to clarify whether or not these white-LEDs may be used as economical light-weight sources in plant factories by examining what styles of spectrum distribution square measure higher fitted to plant production. AN experimental trial was dole out by victimisation seven LEDs, within which dance band of six were white-LEDs, to equate the presentation in making lettuce, and therefore the outcomes were equated with new studies that cast-off white-LEDs for rising lettuce below isolated-system creating circumstances. Consequences displayed that broad-spectrum white-LEDs achieved meaningfully improved than narrow-spectrum LEDs. Amongst lights in conservative color bands, red and blue lights stretch serious belongings on plant growth, not in separation however in mixture; "cool" white LEDs accomplish higher. The dance bands of inexperienced and far-red lights too have around optimistic results. Altogether, for a given intensity level, broad-spec- trum white LEDs outmatch narrow-spectrum LEDs. It's been determined that the vary spreading for white-LEDs to achieve high output in lettuce creating is specified the proportion a part of gauge boson thinness density by typical color band cascades within the subsequent ranges: 1/3 ; < blue; < half-hour, 0%; < green; < 50%;, 30%; < red; < 70%; and 0%; < far-; red < 2 hundredth.(13)

Within the winter season because of insufficient and inadequate exposure to lightweight might delay outcome in a very production periods and therefore the desired result won't be possible for seedlings in greenhouses for plug growers. To beat from this downside, AN attendant attendant lighting to plug seedlings for desired result output. The core thought of this study is to assess the impact of the length of the supplementary light-weight on the expansion and development of 2 watermelon cultivars, 'Speed' and Sambok Honey' grafted onto 'RS-Dongjanggun' calabash rootstocks (*LagenariasicerariaStanld*). Seedlings were adult for ten days throughout a building with a mean daily natural strength of 340 strength chemical action gauge boson strength density (PPFD) and daily supplementary lighting of eight, twelve or sixteen h from mixed LEDs (W1R2B1, chip quantitative relation of white:red:blue = 1:2:1) at a light-weight intensity of one hundred strength PPFD, a gaggle while not supplementary light-weight was set as a result of the management (CK).(14)

The culture environment in a glasshouse had 25/15°C day/night temperatures, an 85±5% comparative humidity, and a usual photoperiod of 8 hours. The results showed that all the growth and development parameters of seedlings grown with

supplementary light were significantly greater than those without supplementary light (CK). It has been observed that 12 hours and 16 hours added light caused in better development and growth bounds than the 8 hours extra light did. It further observed that 12 hours and 16 hours light additions bring about in better Dickson's excellence indexes equated to the 8hour extra light, and the 12 hours extra lights payable the utmost use high efficiency of the add-on light. It also observed that 16 hours of everyday extra light significantly augmented the H₂O₂ gratified and the antioxidant enzyme activities in seedlings compared to the other treatments. This indicated that 16 h of supplementary light led to sure pressures in watermelon sprouts. In our finding it would be in view of the energy feeding, 12 hours of supplementary light was the greatest efficient in cultivating the excellence of the two cultivars of imbedded watermelon plug sprouts.

III. RESULTS AND DISCUSSIONS

It has been found that Water Cooled LEDs base automation in indoor horticulture gives encouraging results in agriculture production and would be an alternative source to increase the agriculture production. This study would be further researched for better results.

IV. CONCLUSION

By Introducing "Automated Indoor System", with LED as light source and its temperature-controlled environment, delivers the requirements of cultivation crops for its adequate plant growth. It's observed that the Arduino circuit excellently controls the physical parameters such as (Temperature, Humidity, Soil moisture etc) and validates the parameters measured within the device through the LCD. By using "Water Cooled LEDs" the automation has been implemented

at indoor Horticulture system. Right now, in this project, we fabricated the PCB model and programming for "ARDUINO UNO ATMEGA 328", by which we can achieves and control the physical parameters such as (Temperature, Soil moisture, Humidity and sound of flies or insects).

In balance 60% of work, we will achieve the "Water-Cooled LEDs" and programming phase of final prototype model. We would also prepare comparative study between conventional methods to grow crops versus WCL method.

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