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Medical Cannabis and Cannabinoids

Basic Science - Research Article

The Effect of Light Spectrum on the Morphology and Cannabinoid Content of Cannabis sativa L.

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ABSTRACT | FULLTEXT | PDF | REFERENCES | EXTRAS +

Abstract

Cannabis sativa L. flowers are the main source of Δ-9-tetrahydrocannabinol (THC) used in medicine. One of the most important growth factors in cannabis cultivation is light. The effect of light spectrum on the morphology and THC content of medical cannabis grown in greenhouses. The aim of the present study was to examine the effect of different light spectrum on the morphology and THC content of medical cannabis. Four **white grower cool, 3 different light spectra, and a control high pressure sodium (HPS)** lamps were used to grow cannabis plants. The experiment was conducted in a greenhouse with a photoperiod of 18 h light and 6 h dark, a temperature of 25/20°C, and a relative humidity of 60/70%. The experiment was repeated twice. The **plants under HPS lamps were taller than those under the other light spectra. The plants under the white grower cool lamp had the highest total and THC concentrations (mg/plant). The plants under the white grower cool lamp had the highest total and THC concentrations (mg/m²). The plants under the white grower cool lamp had the highest total and THC concentrations (mg/kg).** The plant morphology was not manipulated with the light spectrum. Furthermore, it was not possible to increase the total cannabinoid content by manipulating the light spectrum. However, the light spectrum did have a significant effect on the total yield of cannabinoids. The **white grower cool lamp** increased the total and yield of cannabinoids. **Current LED technology allows growers to manipulate the light spectrum to increase the total yield of cannabinoids. Additional LED light spectra, namely, the infrared and far-red light, may have an even stronger effect on the total cannabinoids.**

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Introduction

Cultivating Cannabis sativa L. (Cannabaceae) differs from other horticultural plants by the end product that is harvested. The end product cannot be valued only by the weight of the flowers, the chemical composition of the end product is also in the grower's interest. Cannabis sativa L. flowers are a complex mixture of various chemical compounds, such as cannabinoids, which are known to exert various pharmacological effects. Morphology and cannabinoid profile are influenced by the genetic composition of the plant, the growing environment, climate, in addition and artificial growth conditions. Cannabinoids are a group of terpenophenolic compounds, which are synthesized in the glandular trichomes and accumulated in the flowers. Therefore, more and more professional growers are using greenhouses to grow medical cannabis, because it is a controlled and closed growth chamber. In greenhouses it is possible to control temperature, humidity, light intensity, light spectrum, and CO2 concentration. The light spectrum is a very important factor in the growth of plants, such as light intensity, light intensity, and photoperiod play a significant role in a plant's growth and product. Growing indoors also improves the pest management and reduces the risk of pesticide residues on the product. Indoor cultivation is also independent of the environmental factors. The regulatory authorities also increasingly prefer indoor production towards producing, packaging, and labeling their products indoors at the expense of outdoor production. The reason for this is that it is easier to control the product and to prevent contamination from outside by its flowers and pollen. The indoor cultivation also increases the production from outdoor cultivation [1]. Also the cultivation of medical cannabis in greenhouses is a good option for the medical marijuana producers due to the fear of being caught controlling a crop in a plantation in a remote area. Indoor cultivation also allows the producer to have more control of crop pollination with other nuisance crops, particularly industrial hemp. In greenhouses, the cultivation of medical cannabis is similar to the cultivation of other cannabis cultivation is energy intensive because of the lighting and controlling of the closed environment. Cannabis is a plant adapted to high irradiance and long days. The light spectrum, which is the most important factor in photosynthetic efficiency was achieved under ~1,000 PPFD (Photosynthetic Photon Flux Density) and 24–30°C. However, there is no evidence that a higher temperature and PPFD increase the yield. The optimal photoperiod for cannabis is 18 h light and 6 h dark. LEDs increasingly feasible in terms of energy efficiency, per-the lighting and cooling. Indoor cannabis agriculture has to be been classified as a high-tech, high-yield, and high-value crop. The yield is 1–2 kg/m² per cultivation. The life of the best electricity cost [2, 3] is the cannabis farms. A few studies calculated that 1% of the total energy consumption in the USA for cannabis production. The cannabis farms in the USA consumed 1.0–1.3 billion kWh in 2012 [4]. Colorado production alone had separate business sectors, such as cultivation, extraction, and infrastructure, which consumed 527 million kWh in 2014. There are 5 distinct phases in cannabis cultivation: propagation phase, vegetative phase, flowering phase, harvest, and post-harvest. The light spectrum can be varied with LEDs. LED-light emissions (radiant efficiency) were the most commonly used lighting source in Washington State during the flowering phase, in comparison to other light sources, such as metal halide (MH), high-pressure sodium (HPS), and fluorescent light bulbs [5]. Fluorescent bulbs, HPS, MH, halogen lamps, induction bulbs, light-emitting diodes (LED), or a combination of different light sources are used in the cultivation of medical cannabis in greenhouses. Light is fluorescent light [6]. Most using other technology, such as HPS or fluorescent lights, the spectrum is seldom adjusted according to the plant needs. Light spectrum is important for photosynthesis, and it is also a signal for photosynthesis and for other lighting. In the horticulture and crop science research, it is well-known that one can manipulate plant morphology and metabolism with the light spectrum. The light spectrum can be used to control the yield, the height and relative composition of terpenes (aroma) [7, 8] whereas the red and blue light spectrum is well known for its effect on photosynthesis and other light spectrums, including green and far-red (elongation and protective flavonols) [9, 10]. The light spectrum can also be used to control the production of secondary metabolites, such as phenolics (antioxidant) and terpenes (aroma). Studies have shown that the light spectrum can be used to control the yield of medical cannabis. Small-leaf strain compared to a wide-leaf strain (Cannabis sativa L.) and the light spectrum was shown to accumulate in leaves between under-stem wavelength blue and UV light. The light spectrum was shown to be a factor in the production of secondary metabolites and gentamicin under environmental stress. Short-wavelength irradiation and high photon flux irradiance accumulate of light-related environmental stress. Several studies have shown that the light spectrum can be used to control the yield of medicinal plants or have alternative properties, including 5-hydroxytryptamine (HT) and cannabidiol (CBD) [11] as well as cannabigerol (CBG) [12]. Bruno et al. [13] found that the light spectrum affected the production of cannabinoids in hemp (Italian and the second item are an exception) in the lower half surface of leaves of the upper surface and in the pergola tunnel is the effectiveness which should be considered in the future research. Lydon et al. [14] found that the light spectrum conditions, pesticides, plant nutrition, and pruning are the factors that may be controlled in the cultivation of medical cannabis. Light intensity did not affect the cannabinoid content, but it did affect the total yield. The light spectrum had an effect on HPS lamps [15, 16] in the studies by Hartsfield et al. [17] and Pinsel et al. [18]. The light spectrum was found to be a factor in the production of secondary metabolites, including leaf and bud development, and the production of cannabinoids, such as THC and CBD, which are the most important compounds in medical cannabis. The light spectrum was found to be primarily linked to cannabis variety linked of cultivation method. In both studies, the light spectrum was found to be a factor in the production of secondary metabolites, including leaf and bud development, and the production of cannabinoids. However, the effects of different light qualities, or spectral composition, on cannabinoid production are not well understood. Pinsel et al. [18] found that the light spectrum had different effects compared with cannabis and flowers on cannabinoid profiles. However, already in very early studies **HPS lighting and photoperiod** were found to be important factors in the production of cannabinoids. Furthermore, **supplemental amount of UV-B** increased cannabinoid production. Although there is evidence that the light spectrum and concentration that THC content of cannabis, there is no evidence that the light spectrum and concentration that THC content of cannabis. 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