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Lit Review

Effects of Light Intensity and PAR on Hemp Growth and Development

Light intensity and PAR

There are four components to light that are necessary for plant growth and development: quality, intensity, daily light integral (DLI) and day duration. Light quality describes the different wavelengths of light that affect the plant. Plants use a specific range of wavelengths, called the photosynthetically active range. This range is from 400 nm and 700nm (Nelson 2012). The different wavelengths trigger different processes in the plant’s cells, which is responsible for all the plants living actions. Higher than optimal light can slow down plant growth because the increased radiation denatures the proteins in the chloroplast.

Using shade for fruit and vegetable production

Solar radiation travels to the earth in several different forms, including x-ray, ultraviolet, infrared and visible. Ultraviolet radiation is what causes sunburns on humans, and it can also be damaging to plants in excess. Light comes to the earth in the form of shortwave radiation, light that is reflected off objects like the ground or buildings is longwave infrared radiation; the plant utilizes both.

Sunburn injury is common in higher altitude climates like Utah, as the article explains, and in Colorado. Excess energy from ultraviolet, which is intensified in the altitude. contributes to cell death. Solar injury can be reduced by artificial methods such a sunshade (Maughan et al. 2017). Shade cloths can also decrease leaf surface temperatures.

Photosynthetically active radiation and root zone temperature

The first article examines the influence of irradiance on air and root zone temperatures on yield components of *Rubus iadeus* ‘Autumn Britten. iming of floral bud development, berry quality and root temperatures were monitored in this experiment. A randomized complete block design, in a high tunnel, with split-plot arrangements of treatments were used. A white shade cloth with a 33% shade factor was the covering for the high tunnel (Riesselman 2014). Root-zone temperature was the most influential climatic parameter in the experiment, followed by PAR and finally air temperature.

The ambient air temperature ranged from 20 to 30 C for most of the 2013 production season. Because root-zone temperatures are greater in tunnels compared to field, mitigation techniques of shade cloths and mulches are implemented to decrease root-zone temperatures. In 2012, the berry yield was decreased due to climactic extremes of PAR, which effected the air and root zone temperatures (2014). In conclusion, the study found that small PAR variance did not affect floral bud initiation or berry quality. Root-zone temperature was the most influential component of the variability in yield, which can be attributed to higher PAR and climactic changes.

Productivity, PAR, LUE

Vegetation productivity can be defined as the production of organic matter by plants through photosynthesis. Carbon exchange between the crop and the atmosphere has a direct correlation with the amount of photosynthetically active radiation absorbed (Gitelson et al. 2015). The study used quantum sensors at three sites, measuring hourly incoming PAR. This data was then compared to the growth and development of soybean and maize. The results from experimentation strongly suggested that the decrease of photosynthetic activity was to due excessive PAR that cannot be efficiently utilized by the plants.

Effects of environmental stresses on hemp

Hemp has been observed in instances as going “hot” when environmental stresses get too high. Although not proven yet, growers who experienced high heat or drought have noticed a trend in THC spikes from their crops. In North Carolina, 400 hemp samples were taken, and close to 10% came back over 0.3% THC; which can be correlated with environmental stresses (Place 2018). The high amount of light received in Colorado is a stressor for hemp.

Development and validation of genetic markers for sex and cannabinoid chemotype in hemp

Environmental factors such as high light and heat can stress the plant out enough to make it turn into a hermaphrodite or change sex completely. *Cannabis sativa* is usually dioecious, having male and female flowers on separate plants. Maximal production of CBD occurs in unpollinated female hemp plants. The capitate trichomes of unpollinated female inflorescences have the highest concentration of cannabinoids (Toth et al 2020).

The study also isolated cannabinoids of the female plants at maturity. The top 10cm of the inflorescence was taken and dried in a greenhouse. The cannabinoids were then extracted using ethanol in a high-speed shaker. Cultivar was found to be the best predictor of total cannabinoid concentration. There were differences, however, in the CBD:THC ratio, which could be attributed to changes in the environment. The author notes at the end that “additional studies of the influence of environment on cannabinoid production coupled with individual plant genotyping may lead to a better understanding of the regulation of cannabinoid production” (2020).

Works Cited

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