

RINGKASAN

Plant factory adalah teknologi baru dalam budidaya tanaman dengan lingkungan terkontrol dan mampu memproduksi tanaman berkualitas tinggi sepanjang tahun. Namun, pada pertanian *indoor* ini tentu saja masih terdapat kendala yaitu tanaman tidak mendapatkan penyinaran cahaya matahari secara langsung. Cahaya matahari merupakan salah satu faktor terpenting bagi tumbuhan terutama karena perannya dalam kegiatan fisiologis seperti fotosintesis dan respirasi. Spektrum cahaya yang dibutuhkan tanaman yaitu panjang gelombang pada kisaran 400 hingga 700 nanometer (nm), yang biasa disebut cahaya tampak atau pada ilmu pertanian dikenal dengan istilah *Photosynthetically Active Radiation* (PAR). Salah satu solusi untuk memenuhi kebutuhan cahaya yaitu dengan memanfaatkan sumber cahaya buatan. Penelitian ini bertujuan untuk mengkaji: 1) Pengaruh variasi sumber cahaya buatan terhadap respon fisiologis tanaman bayam merah dalam sistem *plant factory*; 2) Pengaruh variasi sumber cahaya buatan terhadap produksi biomassa tanaman bayam merah dalam sistem *plant factory*.

Penelitian dilaksanakan di Laboratorium Teknik Pengelolaan dan Pengendalian Bio-Lingkungan (TPPBL) dan Laboratorium Agronomi dan Hortikultura, Fakultas Pertanian UNSOED pada bulan April sampai dengan November 2021. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK) dengan 3 ulangan. Perlakuan terdiri dari 1 faktor yaitu variasi warna cahaya dengan 4 taraf A = lampu LED merah biru, B = lampu LED tub putih, C = lampu LED merah, D = lampu LED biru. Variabel penelitian meliputi tinggi tanaman, jumlah daun, luas daun, indeks luas daun, bobot segar tanaman, bobot kering tanaman, kerapatan stomata, laju asimilasi bersih, laju pertumbuhan relatif, kandungan karotenoid, kehijauan daun, lebar bukaan stomata, dan panjang akar total. Data dianalisis menggunakan anova dan apabila berbeda nyata maka diuji lanjut menggunakan uji BNT pada taraf 5%.

Hasil penelitian menunjukkan bahwa variasi warna cahaya buatan mampu meningkatkan respon fisiologis dan produksi biomassa tanaman bayam merah pada budidaya *plant factory*. Cahaya lampu LED merah biru memberikan peningkatan respon fisiologis terbaik pada tinggi tanaman pada tinggi tanaman sebesar 21,96 cm, jumlah daun 14,13 helai/tanaman, luas daun 22,16 cm², kerapatan stomata 99,01 unit/mm², kehijauan daun 28,29 SPAD Unit, dan panjang akar total 606,89 cm. Cahaya lampu LED Biru menunjukkan kemampuan terbaik dalam meningkatkan kandungan karotenoid sebesar 526,55 µmol/L. Cahaya lampu LED merah biru memberikan produksi biomassa tertinggi pada laju asimilasi bersih sebesar 376,0 mg/dm²/minggu, laju pertumbuhan relatif 1,54 mg/minggu, indeks luas daun 1,86, bobot segar tanaman 11.918 mg, dan bobot kering tanaman 943,87 mg.

SUMMARY

Plant factory is a new technology in plant cultivation with a controlled environment and capable of producing high quality crops all year round. However, in indoor farming, of course, there are still obstacles, namely that the plants do not get direct sunlight. Sunlight is one of the most important factors for plants, especially because of its role in physiological activities such as photosynthesis and respiration. The spectrum of light needed by plants ranges from a wavelength of 400-700 nanometers (nm), which is commonly called Photosynthetically Active Radiation (PAR). One solution to meet the needs of light is to utilize artificial light sources. This study aims to examine: 1) The effect of variations in artificial light sources on the physiological response of red spinach in the plant factory system; 2) The effect of variations in artificial light sources on the biomass production of red spinach in the plant factory system.

The research was carried out at the Bio-Environmental Management and Control Engineering Laboratory (TPPBL) and the Agronomy and Horticulture Laboratory, Faculty of Agriculture, UNSOED from April to November 2021. This study used a Randomized Block Design (RBD) with 3 replications. The treatment consisted of 1 factor, namely the variation of light color, with 4 levels: A = red-blue LED light, B = white tub LED light, C = red LED light, D = blue LED light. The research variables included plant height, number of leaves, leaf area, leaf area index, plant fresh weight, plant dry weight, stomata density, net assimilation rate, relative growth rate, carotenoid content, leaf greenness, stomata opening width, and total root length. The data were analyzed using ANOVA and if they were significantly different then further tested using the BNT test at the 5% level.

The results showed that variations in the color of artificial light were able to increase the physiological response and biomass production of red spinach in plant factory system. Red and blue LED lights gave the best physiological response increase in plant height at plant height of 21.96 cm, number of leaves of 14.13 strands/plant, leaf area of 22.16 cm², stomata density of 99.01 units/mm², leaf greenness of 28.29 SPAD Units, and a total root length of 606.89 cm. Blue LED light showed the best ability to increase the carotenoid content by 526.55 mol/L. Red and blue LED lights gave the highest biomass production at a net assimilation rate of 376.0 mg/dm²/week, a relative growth rate of 1.54 mg/week, a leaf area index of 1.86, a plant fresh weight of 11,918 mg, and a dry weight of 943.87 mg.