ABSTRACT

OIL PALM SEEDLING GROWTH MODEL (*Elaeis guineensis* Jacq.) IN THE MAIN NURSERY STAGE, USING BACKPROPAGATION NEURAL NETWORKS

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The initial activity in oil palm cultivation, which is very important and influences the performance of oil palm plants during their economic life, is nursery. The main factors affecting seedling growth are climatic and soil conditions such as air temperature (°C), air humidity (%), light intensity (W/m^2), and rainfall (mm), as well as plant nutrient requirements which are also important elements in sustaining plant growth. Research and studies on plantation commodities, especially oil palm, generally require a long time, so a mathematical study approach is needed that allows reducing this time by modeling and simulation. The revolutionary artificial intelligence-based modeling and simulation used in this research is the Backpropagation Neural Network (BPNN). This research aims to develop a prediction model for the growth of oil palm seedlings. Field data collection was based on observations of the parameters of plant height, number of leaves, stem diameter, and leaf chlorophyll content in oil palm seedlings from 1 month after planting to 9 months in the Main Nursery stage. Along with environmental observation data and applied fertilization data. Development of the BPNN model with the input parameters of temperature, humidity, sunlight intensity, rainfall, N, P, K, and Mg nutrients with the output parameters of plant height, number of fronds, stem diameter, and chlorophyll index. Development of a model for estimating the height of oil palm seedlings with the BPNN 10-8-1 network architecture obtained an accuracy value based on the correlation coefficient (R) of 0.969; coefficient of determination R^2 (0.94), coefficient of the MSE evaluation model (0.0028), and RMSE (0.053). Development of the BPNN model for estimating the number of leaves of oil palm seedlings obtains the accuracy value R of 0.902, R^2 (0.81), MSE (0.0061), and RMSE (0.053) on the BPNN 10-25-1 network architecture. Furthermore, in developing a model for estimating the diameter of the oil palm seedlings, the accuracy value (R) was 0.957; R^2 (0.91), MSE (0.0042), and RMSE (0.064) on the BPNN 10-8-1 network architecture. Whereas in the construction of a model for estimating the chlorophyll index of oil palm seedlings on the BPNN 10-3-1 network architecture, the R, R^2, MSE, and RMSE successively were 0.465; 0.216; 0.0137; and 0.117. The model simulation results for estimating seedling height, number of fronds, stem diameter, and chlorophyll index of oil palm seedlings showed that the percentage of error rate based on MAPE value was 12.01%; 10.67%; 16.19%; and 15.61%.

Keywords: backpropagation neural network, model prediction, oil palm seedling

INTISARI

MODEL PERTUMBUHAN BIBIT KELAPA SAWIT (*Elaeis guineensis* Jacq.) PADA TAHAP PEMBIBITAN UTAMA MENGGUNAKAN *BACKPROPAGATION NEURAL NETWORK*

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Kegiatan awal dalam budidaya kelapa sawit yang sangat penting dan berpengaruh terhadap kinerja tanaman kelapa sawit selama umur ekonomisnya adalah pembibitan. Faktor utama yang mempengaruhi pertumbuhan bibit adalah kondisi iklim dan tanah seperti suhu udara (^oC), kelembaban udara (%), intensitas cahaya (W/m^2), dan curah hujan (mm) serta kebutuhan hara tanaman juga menjadi unsur penting dalam menopang pertumbuhan tanaman. Penelitian dan kajian terhadap komoditas perkebunan terutama kelapa sawit pada umumnya memerlukan waktu yang panjang, sehingga diperlukan suatu pendekatan kajian secara matematis yang memungkinkan untuk mereduksi waktu tersebut dengan pemodelan dan simulasi. Pemodelan dan simulasi revolusioner berbasis *Artificial intelligence* yang digunakan dalam penelitian ini adalah *Backpropagation Neural Network* (BPNN). Tujuan penelitian ini adalah mengembangkan model pendugaan pertumbuhan bibit kelapa sawit. Pengumpulan data lapangan berdasarkan pengamatan terhadap parameter tinggi tananam, jumlah daun, diameter batang, dan kandungan klorofil daun pada bibit kelapa sawit sejak umur 1 bulan setelah tanam hingga 9 bulan pada tahap *Main Nursery*. Beserta data pengamatan lingkungan dan data pemupukan yang diaplikasikan. Pengembangan model BPNN dengan parameter *input* suhu, kelembaban, intensitas cahaya matahari, curah hujan, hara N, P, K, Mg dengan parameter *output* tinggi tanaman, jumlah pelepah, diameter batang, dan indeks klorofil. Pengembangan model pendugaan tinggi bibit kelapa sawit dengan arsitektur jaringan BPNN 10-8-1 diperoleh nilai akurasi berdasarkan koefisen korelasi (R) sebesar 0.969; koefisien determinasi R^2 (0,94), koefisien model evaluasi MSE (0,0028), dan RMSE (0,053). Pengembangan model pendugaan jumlah daun bibit kelapa sawit, R sebesar 0.902; R^2 (0,81), MSE (0,0061), dan RMSE (0,053) pada arsitektur jaringan BPNN 10-25-1. Selanjutnya pada pengembangan model pendugaan diameter batang bibit kelapa sawit nilai (R) sebesar 0,957; R^2 (0,91), MSE (0,0042), dan RMSE (0,064) pada arsitektur jaringan BPNN 10-8-1. Sedangkan pengembangan model pendugaan indeks klorofil bibit kelapa sawit pada arsitektur jaringan BPNN 10-3-1 berturut-turut R, R^2, MSE, dan RMSE sebesar 0,465; 0,216; 0,0137; dan 0,117. Hasil simulasi model untuk pendugaan tinggi bibit, jumlah pelepah, diameter batang, dan indeks klorofil bibit kelapa sawit menunjukkan persentase tingkat kesalahan pendugaan berdasarkan nilai MAPE berturut-turut 12,01%; 10,67%; 16,19%; dan 15,61%.

Kata kunci : *backpropagation neural network*, bibit kelapa sawit, model pendugaan