Estimation of Plant Height and Aboveground Biomass of Toona sinensis under Drought Stress Using RGB-D Imaging

发布者： [发表时间]：2021-12-14 [来源]： [浏览次数]：485

论文作者：Wenjian Liu, Yanjie Li*, Jun Liu and Jingmin Jiang

期刊来源：Forests

论文摘要：

Background: Rapid and accurate plant growth and biomass estimation is essential for formulating and implementing targeted forest cultivation measures. In this study, RGB-D imaging technology was used to obtain the RGB and depth imaging data for a Toona sinensis seedling canopy to estimate plant growth and aboveground biomass (AGB). Three hundred T. sinensis seedlings from 20 varieties were planted under five different drought stress treatments. The U-Net model was applied first to achieve highly accurate segmentation of plants from complex backgrounds. Simple linear regression (SLR) was used for plant height prediction, and the other three models, including multivariate linear (ML), random forest (RF) and multilayer perceptron (MLP) regression, were applied to predict the AGB and compared for optimal model selection. The results showed that the SLR model yields promising and reliable results for the prediction of plant height, with R2 and RMSE values of 0.72 and 1.89 cm, respectively. All three regression methods perform well in the prediction of AGB estimation. MLP yields the highest accuracy in predicting dry and fresh aboveground biomass compared to the other two regression models, with R2 values of 0.77 and 0.83, respectively. The combination of Gray, Green minus red (GMR) and Excess green index (ExG) was identified as the key predictor by RReliefF for predicting dry AGB. GMR was the most important in predicting fresh AGB. This study demonstrated that the merits of RGB-D and machine learning models are effective phenotyping techniques for plant height and AGB prediction, and can be used to assist dynamic responses to drought stress for breeding selection.

doi: https://doi.org/10.3390/f12121747

论文链接：https://www.mdpi.com/1999-4907/12/12/1747/htm