Regression model for Stem Length of Soybean using Multispectral Image

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This study took place in an experimental field of the Southern Crop Division of the National Institute of Crop Science in Miryang-si, Gyeongsangnam-do. it was conducted on soybean (Glycine max (L.) Merr.) grown in three cultivation methods (ABD, ADD, and WWW; the first word, A implies automatic irrigation, the second word means weed control by boom sprayer(B) and a drone(D), the third word D, means disease and Insect pest control with a drone, WWW means without irrigation, weed, and insect pest control). Seonpung was sown on June 20th, and twenty samples of stem length were measured in ABD and WWW, respectively, and ten samples of stem length in ADD on August 20th. The image (GSD: 25@1.08cm/pixel) was acquired by a drone equipped with a multispectral sensor (Altum-PT, MicaSense Inc, USA) on August 22nd. The reflectance value of soybeans was extracted by ENVI 5.3 (Exelis Visual Information, USA), and the vegetation indices (NDVI, GNDVI, GRVI, RVI, DVI, NDRE, OSAVI, TCARI) were aclculated. After removing the outliers of the measured data, an ANOVA analysis was performed. After diagnosing multicollinearity with VIF, the datasets were separated into 6:4, 7:3, and 8:2 to create a multilinear regression models by Python 3.9.13. The best model was selected based on more than 0.6 of R^2, less than 10 of MAPEC and MAPEP, and the minor difference between RMSEC and RMSEP.

In the result of ANOVA, there is no difference in stem length among ABD, ADD, and WWW. Therefore MLR models were established depending on any combination of cultivation methods. However, it was impossible to make the models that satisfied the condition of the best model regardless of any combination of cultivation methods. Therefore the estimation models were estimated depending on each cultivation method. The best models for the stem length were selected for each cultivation method, such as R^2=0.66, RMSEC=2.84cm, MAPEC=8.95%, RMSEP=2.65cm, MAPEP=4.61% for ABD(6:4), and R^2=0.71, RMSEC=2.03cm, MAPEC=7.15%, RMSEP=3.46cm, MAPEP=5.68% for ADD(7:3), and with R^2=0.68, RMSEC=0.77cm, MAPEC=2.32%, RMSEP=2.40cm, MAPEP=2.88% for WWW(6:4), respectively.

In the future, it is expected that growth monitoring using the results of this study and the creation of a yield prediction model using harvest season images will help improve the stability of soybean production.

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