Yield Prediction of Onion (*Allium cepa* L.) Using Hyperspectral Imagery and Climatic Factors

Ye-Seong Kang (1), Sae-Rom Jun (1), Si-Hyeong Jang (1), Hye-Young Song (1), Jun-Woo Park (1), Chan-Seok Ryu (1)

[1] Division of Bio-System Engineering, Gyeongsang National University, Jinju, 52828, Republic of Korea

Email: ryucs@gnu.ac.kr

Abstract: Climatic change has been a threat to cultivation stability with loss of agricultural land, water shortage and advancing north of cultivated land. Therefore, it is essential to steadily monitor the crop growth for rapidly responding to problems of the climate or cultivation form every year. The objective of this study was to predict the yields of onion (*Allium cepa* L.) using hyperspectral imagery containing many spectral bands and climatic factors for two years (2016-2017 and 2017-2018). The hyperspectral imageries were acquired in hyeongyeong-myeon, muan-gun, Republic of Korea (35°58´03.2´´ N, 126°27´14.6´´ E) and region of the onion canopies were extracted. The spectral bands of 2.8 nm FWHM were merged into 10 nm FWHM at interval of 10 nm from 419 nm to 979 nm based on commercialized band pass filter to develop of small multispectral image sensor. Climatic factors were calculated as effective cumulative temperature (ECT), accumulated precipitation (AP) and accumulated duration of sunshine (ADS) during the growing season of onion. Multiple linear regression models were developed to predict the yields of onion for two years with the climatic factors (each year and average for two years) and key spectral bands selected by stepwise. The key bands were selected into blue (440 and 450 nm), green (540 and 550) and NIR (820 nm) for 10 nm FWHM. The model developed by climatic factors in each year and the key spectral bands was R^2 0.76, root mean squares error (RMSE) 168 g/m^2 and relative error (RE) 49.9%. To increase performance of model and minimize low sensitivity model generated by the different climatic factors in each year, climatic factors averaged for two years were used to develop the model. The model was highly increased as R^2 0.86, root mean squares error (RMSE) 131 g/m^2 and relative error (RE) 38.8%. As a result, it might be possible to increase predictability if the climate factors are continuously updated with the key spectral band of hyperspectral images to predict onion yields.

Keywords: Climatic factor, hyperspectral imagery, multiple linear regression, onion, stepwise

Acknowledgement: This work was performed with the support of 'Advanced Production Technology Development Project' (Project title: Development of a UAV-based remote sensing technology for monitoring the growth of major upland crops, Project No.: 315011-03-3-HD020), IPET (Korea Institute of Planning and Evaluation for Technology of Food, Agriculture, Forestry and Fisheries), MAFRA (Ministry of Agriculture, Food and Rural Affairs).