

Methods and Models for Grass Cereals' Production Estimation: Case Study in Wheat

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Adequate management of agricultural crops requires, among other things, accessible and sufficiently accurate methods for assessing plant nutrition and crop vegetation status, and for agricultural production estimation.

Sustainable technologies are based on correct decisions, prompt interventions and appropriate works, and correct information in real time, and the obtaining information methods can be simple, accessible, and appropriate in relation to different user categories (e.g., farmers, researchers, decision makers).

This study used mineral fertilization (NPK), with 11 experimental variants, to ensure a controlled differentiated nutrition of the wheat plants, “Alex” cultivar. Regression analysis was used to obtain models in estimating wheat production, by methods based on: (a) NPK fertilizers applied (F) in the 11 experimental variants; (b) physiological indices (PI), represented by the chlorophyll content (Chl), and plant nutrition status on the experimental variants, in terms of macroelement content in the leaves, evaluated by foliar diagnosis (N_{fd} , P_{fd} , K_{fd}); (c) imaging analysis (IA) based on digital images of the wheat experimental variants, and calculated indices (NDI: Normalized Difference Index, INT: Intensity, DGCI: Dark Green Color Index).

A set of models was obtained, with different precision levels and statistical safety: $R^2 = 0.763$, $p = 0.013$ in the case of model based on applied fertilizers (NPK_F); $R^2 = 0.883$, $p < 0.01$ in the case of model based on foliar diagnosis (NPK_{fd}); $R^2 = 0.857$, $p < 0.01$ in the case of model based on chlorophyll content (Chl); $R^2 = 0.975$, $p < 0.01$ in the case of model based on normalized rgb color parameters (RGB color system); $R^2 = 0.925$, $p < 0.01$ in the case of model based on the DGCI calculated index. The model based on applied fertilizers (F model) was tested in relation to wheat production data, for a period of six years, communicated by other studies. Fit degree analysis between predicted yield based on the F model and real yield (six-year average) was confirmed by $R^2 = 0.717$, compared to $R^2 = 0.763$ for the F model in this study.

The models obtained in this study, related to the “Alex” wheat cultivar, can be used for other studies, but with a certain margin of error, given the coefficient values, specific to the obtained equations. The approach concept, methods, and models presented can be opportunities for other studies to facilitate their comparative analysis, their adaptation, and/or development in the form of new models that are useful in different studies, research, or agricultural practices, for their integration into crop management strategies.

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