# Simulating Alfalfa Growth Dynamics of Fall Dormancy Classes Across Environments

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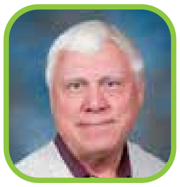

Kenneth J. Boote, Professor Emeritus, Agric and Biol. Engr. Department, University of Florida (kjboote@ufl.edu). Ph.D. in Crop Physiology (Purdue University, 1974). Professional experience at the University of Florida (1974 to present). Research specialization: crop physiology and modeling of crop response to climate change factors ($CO_2$, temperature, and drought) and genetic attributes. Co-developer of dynamic process-oriented models for important crops including soybean, peanut, bean, faba bean, maize, alfalfa, and perennial grass forages used worldwide for research on impacts of and adaptation to climate change and variability (for access to DSSAT crop models, see *dssat.net*). User of these models to enhance physiological understanding, improve crop management strategies, and evaluate physiological traits for genetic improvement. Since 2011, he has served as Coordinator-Crop Modeling for the Agricultural Model Improvement and Intercomparison Project (AgMIP). Authored 56 chapters and 295 refereed articles. Fellow of AAAS, ASA, CSSA.

The CROPGRO-Alfalfa model, released with DSSAT V4.8 software (available at *dssat.net*), simulates daily growth processes of alfalfa (*Medicago sativa*), including herbage harvests, herbage protein, and re-growth over multiple harvests and multiple seasons. The model includes a storage organ (rhizome, taproot, crown) with carbohydrate and N storage pools that provide the ability for re-growth despite zero leaf area index caused by complete shoot harvest or freeze-loss of all leaf tissue. Repeated intensive defoliation and aggressive management can cause poor recovery and loss of the forage stand. The model includes rules for fall dormancy (FD), freeze thresholds, partitioning as a function of growth stage and daylength, re-fill of storage pools, along with mobilization of carbohydrate and N from storage pools to drive re-growth. Varying these parameters allows genetic variation among cultivars and dormancy classes. The CROPGRO-Alfalfa model has been evaluated with growth and yield data from FD-types 3, 4, 6, and 10 grown in contrasting environments in Arizona, Montana, Canada, and Spain. Daylength is the most important variable affecting the FD simulations, using a critical daylength of 9.8 hr at which allocation to storage taproot is most rapid (and less to shoot) and the opposing critical daylength (14.2 h) at which allocation to storage is least rapid (more to shoot). The relative "strength" of daylength-driven partitioning to storage (RDRMT) varies with FD class, with RDRMT of 0.500, 0.320, and 0.140 for FD 3, 6, and 10, respectively. These two features (daylength effect and its strength), along with minor variation in leaf photosynthesis (per FD) allow productivity to vary across the FD classes 3 (Rugged), 6 (Cisco II), and 10 (CUF 101), as observed in the growth and herbage yield of three FD-class cultivars in Arizona and Montana. Simulated yield response of FD classes as affected by environment (sites differing in daylength-temperature) and cutting management will be illustrated.