Derivation of Crop Parameter Attributes for Cropping Systems Modeling

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Needs

- Simulation models require field-based parameter development and field-validation of runs for each species of interest
- Cooperation is essential to:
  - help develop and improve plant parameters
  - validate the model at a wide range of sites, soils, and latitudes
  - make large area yield simulation runs
- Continued ongoing collaboration and development of new collaborations is paramount
Model Outputs

- Plant productivity
- Plant species dominance
- Runoff and infiltration
- Soil erosion (water)
- Drought and nutrient stress impacts
- Nutrient demand and uptake by plants
Plant Parameters for Plant Functional Groups of Western Rangelands

• LAImax
• Values for k
• RUE
• For forbs, grasses, and shrubs
Locations where plant data was collected
Western Rangeland Study

- Results of this multiyear project were published both as individual species values and as functional groups.
- Results were validated by simulating various range sites in the region and comparing to published NRCS yield values.
Summary of Western Grass Parameters

Grass parameters ranged from:

- $LAI_{max}$ 1.0 to 2.1
- $k$ -0.50 to -0.85
- $RUE$ 0.70 to 1.3g MJ$^{-1}$
Conclusions from Western Rangeland Study

• Results demonstrated that assessments with process-based models such as ALMANAC are feasible with realistic estimates of plant parameters for plant functional groups in a region.

• Our measurements of individual species within each functional group provide parameter estimates for these assessments.
Wetland CEAP

- Conservation Effects Assessment Project (CEAP)
- Wetlands are important sinks or filters for sediment, organic carbon, nitrogen and phosphorus
- Need for regional and national wetland assessment
- ALMANAC – Parameterize wetland plant species, simulate management and sustainability of wetland ecosystem
- SWAT – Model wetland hydrology and integrate with other watershed land uses and processes
Wetland Cooperators

- Amber Williams with USDA-ARS Temple
- Megan Lang and Greg McCarty, USDA-ARS, Beltsville, MD
- Loren Smith, Oklahoma St. University
- Dan Keesee and Kelly Attebury, USDA-NRCS, Temple and Lubbock, TX
- David Mushet USGS-Jamestown, ND
Planned Deliverables

• Plant parameters for some representative plant species in key wetland plant functional groups
• These plant parameters will be transferred to other, similar process based simulation models including APEX, SWAT, and EPIC
Field-Based Measurements

- Plant nutrient concentrations and physiological distribution at different phenological stages
- Light extinction coefficient (k) determined from FIPAR measurements and destructive LAI measurements
- Radiation use efficiency: dry matter produced per unit light intercepted over time
Field Data Requirements

- **FIPAR** using the ceptometer
- Area sampled
- Harvest and weigh plant
- **LAI** using the leaf area meter
Data Collected

- At least two to three harvests taken over the growing season
- Fraction photosynthetically active radiation (FIPAR) measured in the field using a ceptometer
- Leaf Area Index (LAI) recorded from harvested species
- K derived from the data to be used in Beer’s Law
- Plant nutrient concentrations
Website links to field measurement protocol

Gathering Field Data

How to use ceptometer: AccuPAR LP-80 Basics Standard
Taking measurements for ALMANAC: Sampling Protocol Standard with Photos
Collecting Data: Field Datasheets
Data Entry Template: FIPAR LAI K Example
Video Explanations showing formulas, how and why we measure the way we do:
  Virtual Seminar: Standardized Methods for Measuring Intercepted PAR in Canopies Using Ceptometer
  Video: Measuring PAR and LAI with Accupar LP-80 Ceptometer
  Decagon Ceptometer: Accupar LP-80
  LI-COR Leaf Area Meter: Li-3100C Area Meter
Maryland

- Cattail
- Smartweed
- Sedge
- Rush
Playas

- Burr Ragweed
- Spike Rush
- **Smartweed**
- Cheeseweed
- Arrowhead (2014)
- Narrowleaf Goosefoot (2013)
North Dakota

- Cattail
- Slough Sedge
- Bulrush
- Smartweed
- Whitetop
- Reed Canary Grass
Ongoing Western Rangeland Research

- Arizona with Lori Metz and Steve Barker on triangle-bursage and creosote bush
- Miles City, Montana with Jennifer Muscha, Mark Petersen, and Robert Killian on threadleaf sedge, needle and thread, green needlegrass, prairie sandreed and winterfat
Ongoing Biofuel Plant Research

• Navy research on Maui with Norman Meki, Susan Crow, Richard Ogoshi, and Mae Nakahata
• Oilseed research with Kim Hunter, Kate Behrman, Dan Long, and many others
• Hybrid poplar work with Tian Guo, Gang Shao and Bernard Engel
Plan:

• Transfer plant functional group/species parameters to EPIC, APEX, and SWAT for various analyses