CROPMAN: A DECISION AID TO ASSESS CROP PRODUCTION STRATEGIES AND MANAGE RISK

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Abstract

CroPMan is a windows-based application of **EPIC** (Environmental/Policy Integrated Climate model) originally developed by USDA-ARS that simulates the interaction of natural resources (soil, water, climate) and crop management practices to estimate impacts on harvested crop yield, soil properties, soil erosion, profitability, and nutrient/pesticide fate. It is designed as a production-risk management aid to help agricultural practitioners optimize crop management and maximize production and profit, to identify limitations to crop yield, to assist growers with replant decisions, and to identify best management practices that minimize impact of agriculture on soil erosion and water quality. **CroPMan** is distributed on CD-ROM and operates under *Windows*® 98 and 2000 with 64 MB RAM. It is installed on a hard-drive (using 250 MB minimum). The databases for basic model operation are organized by agricultural region and contain baseline information for model operation so the user can perform basic operations with minimum effort, but the user can customize this information for his/her site-specific conditions and needs. Databases for model operation are currently available for Texas and Missouri, but can be constructed for other agricultural regions upon request and operation.

Overview of CroPMan Model

Management Practices Simulated:

- Fertilization: N and P (mineral, manure)
- Planting date, crop maturity, crop type, and rotation sequence
- Irrigation
- Plant population & Row spacing
- Tillage/ residue management
- Pesticide (economics and fate)

Databases included:

- Weather: observed daily maximum and minimum temperature and precipitation and monthly statistics from selected class 1 or coop weather sites to operate weather generator
- Soils 5, Management Unit Use Files by County
- Pesticides, Fertilizers & Equipment
- Management: sequential farming operations by cropping system: crop, tillage (conventional, reduced, and no-till), and water application (irrigation versus dryland)

Special Features:

- Unit Conversion: English/Metric
- Generates daily weather from monthly statistics if daily weather data are missing
- Update/ modify soils, weather, crop growth, and management to current conditions
- Performs direct comparisons of soil type/characteristics, cropping systems, management practices to identify best opportunities over- and within- cropping season.
- Information saved and sorted by Producer name, Soil, County, Weather Station, Cropping System, Farm, Field, and Management unit.
- Built in utility to update daily weather records to current day from user collected/supplied daily records.

Applications:

Strategic Assessments (over years)

- Examine production practices for site-specific climate and soil variation to identify production constraints and maximize yield, profit, and production efficiency.
- Assess fertility requirement, and nutrient and pesticide fate

- Identify the “Best Management Practices” for site-specific circumstances to minimize cropping impact on soil erosion, water quality, and runoff.
- Assess climate impacts on productivity: El Nino/La Nina

Real-time Analyses (current year)

- Late planting options (maturity/crop type)
- Replant decisions
- Fertilizer optimization
- Irrigation timing and amount
- Estimate yield & profit
- Nutrients/pesticides in runoff

Output: Graphical/numeric display, hard copy, or saved to digital file

Economics:
Operation, Fixed, & Total Costs
Gross Returns
Cash Flow
Profit

Stresses:
Drought
Low Temperature
Excess Water
Nitrogen
Phosphorus

Crop yield:
Biomass
Yield (grain, forage and/or lint yield)
Nitrogen in yield
Phosphorus in yield

Water balance:
Precipitation
Surface runoff
Water use efficiency
Evapotranspiration
Irrigation applied
Crop available water
Percolation below root zone
Lateral subsurface flow

Nutrient balance:
Phosphorus mineralized
Phosphorus applied
Nitrogen applied
Lime applied
Organic carbon in plow layer (6”)
Organic carbon in soil profile

Non-point Losses:
Soil loss (water erosion – small watershed)
Soil loss (wind erosion)
Soluble phosphorus loss in runoff
Phosphorus in percolate
Phosphorus loss with sediment
Organic nitrogen loss with sediment
Soluble N in surface runoff
Mineral N loss in lateral subsurface flow

Pesticide losses:
Biodegraded (foliage)
Biodegraded (soil)
In drainage system
Remaining In soil (EOM: end of month statistics)
Losses by leaching
Losses in runoff
Losses in sediment
Remaining On foliage (EOM: end of month statistics)

Other:
Planting date
Emergence date and Harvest date

CroPMan Input and Output Screens

Figure 1. CroPMan standard run screen.

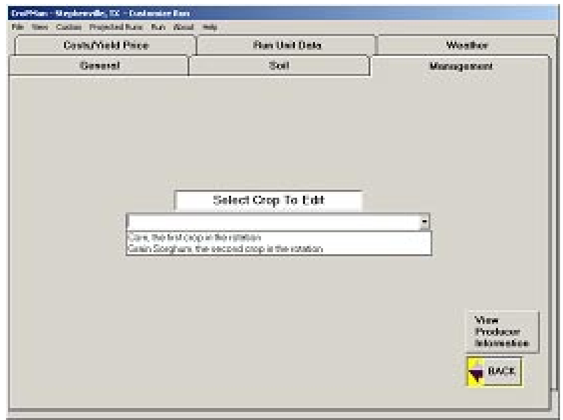

Figure 2. CroPMan customize run screen.

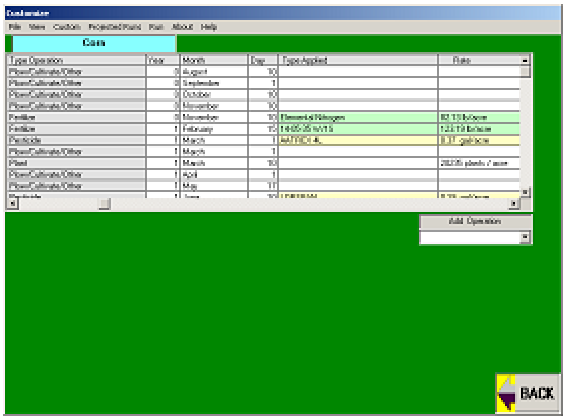

Figure 3. CroPMan screen to customize a Standard Run.

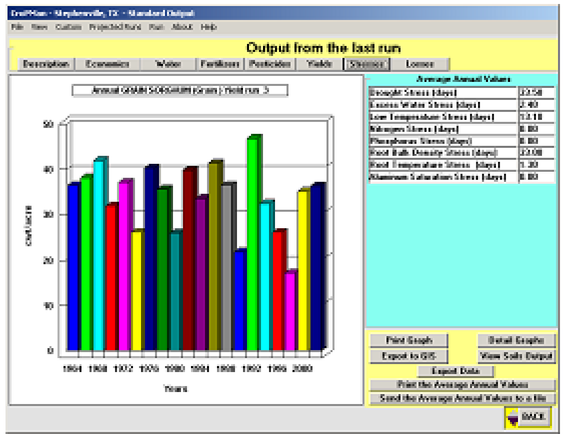

Figure 4. Standard run output graphic screen.

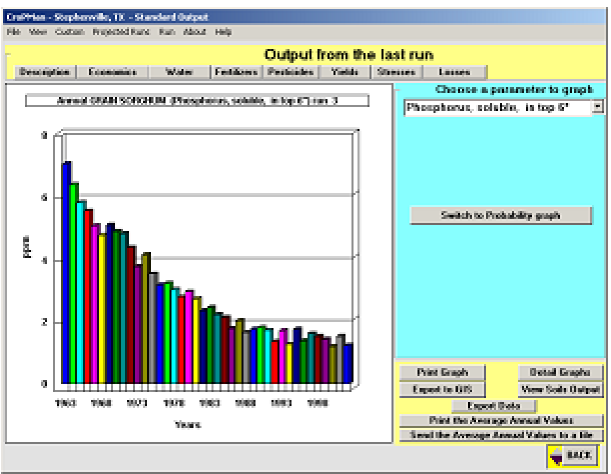

Figure 5. Detail graph information generated from a CroPMan standard run.

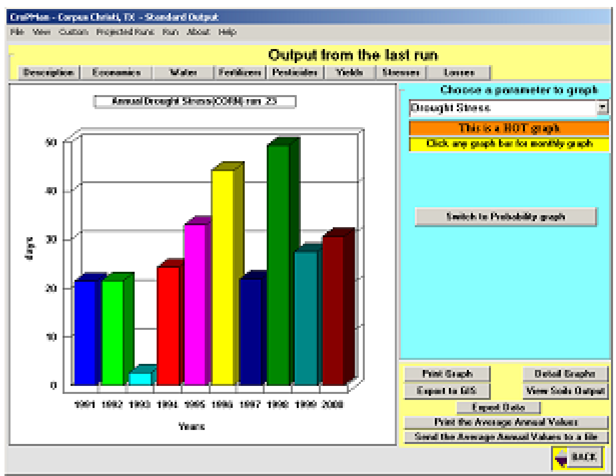

Figure 6. Detail (HOT) graph information generated from a CroPMan standard run that permits user to display monthly and daily information.

CroPMan Validation:

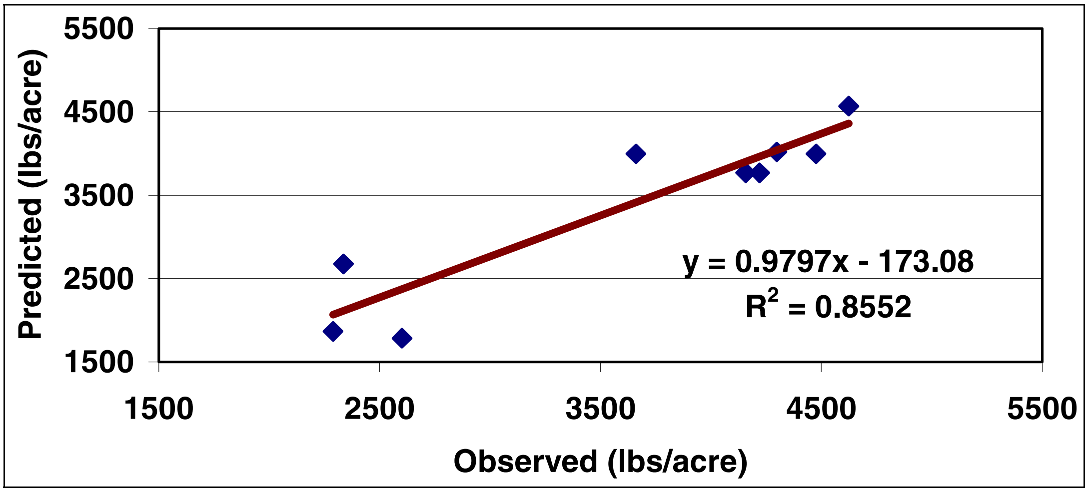

Figure 7. Comparison of observed yield of versus CroPMan predicted grain sorghum yield grown under dryland conditions at the Stiles Farm Foundation in Thrall, TX 1996 to 2000.

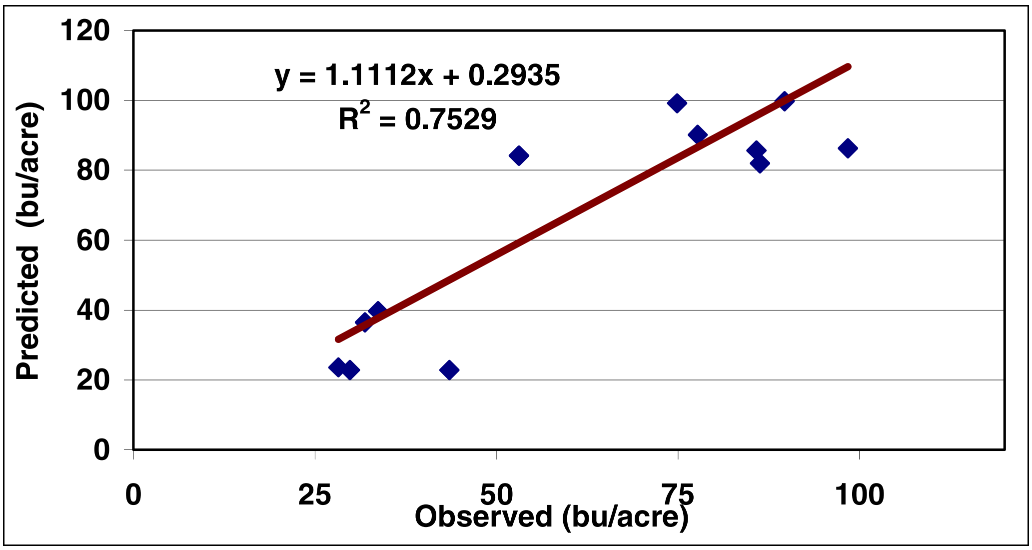

Figure 8. Comparison of observed yield of versus CroPMan predicted corn yield grown under dryland conditions at the Stiles Farm Foundation in Thrall, TX 1996 to 2000.

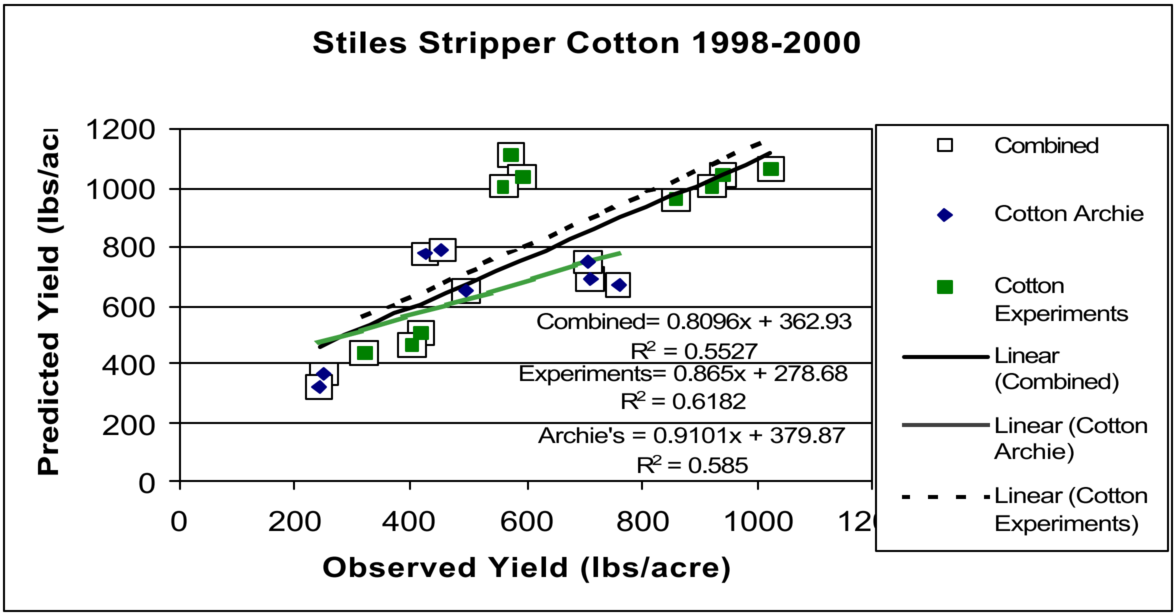

Figure 9. Comparison of observed yield of versus CroPMan predicted cotton yield grown under dryland conditions at the Stiles Farm Foundation in Thrall, TX 1996 to 2000.

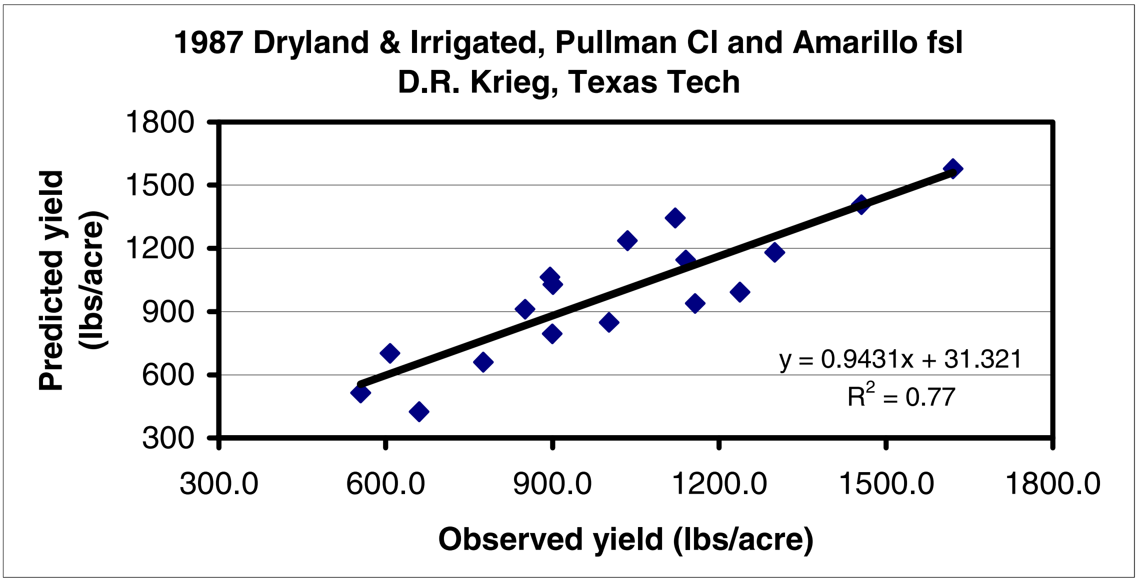

Figure 10. Comparison of observed yield of versus CroPMan predicted cotton yield grown under dryland and irrigated conditions near New Deal and Brownfield, TX in 1987. Data provided courtesy of Dr. Daniel Krieg, Texas Tech University, Lubbock, TX.