Application of the CROPGRO-Soybean Model to Predict Soybean Yield

P. Pedersen and J.G. Lauer

Department of Agronomy
University of Wisconsin-Madison

Background

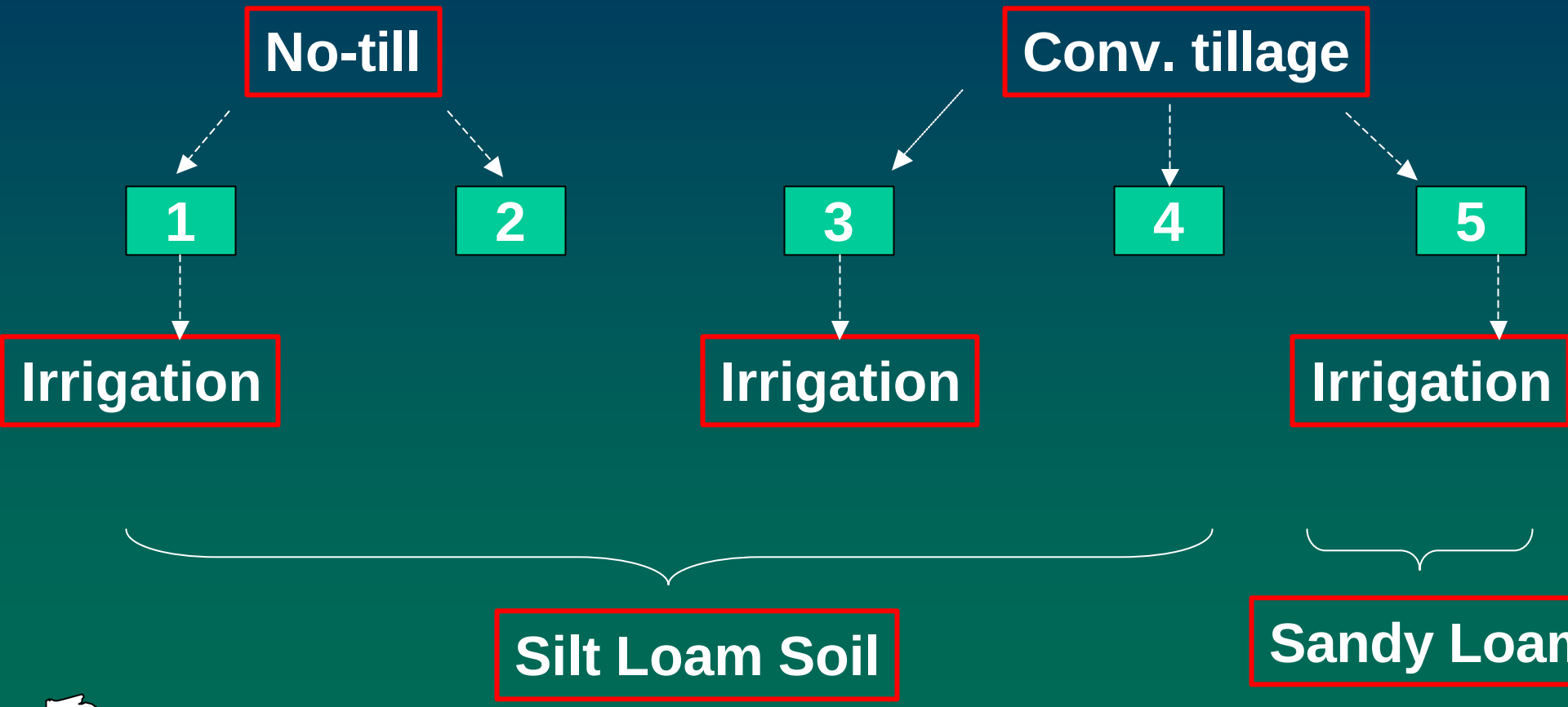
- Soybean production has increased tremendously in WI the last 20 years
- Yield goals are increasing year after year
- Few published studies have measured growth processes during the season to understand how high yields are achieved

Objectives

- To determine current yield potential of soybean under various management systems
- To determine if growth pattern differs between older and newer cultivars under various management systems
- Analyze yield improvements among older and newer cultivars using the CROPGRO-soybean model

Materials and Methods

Studies in 1997-2000 for five different management systems



Materials and Methods

- Each management systems consisted of a RCBD in a split plot arrangement with 4 replications
  - Main plots
    - Two planting dates (early and late May)
  - Split plots
    - Three different cultivars (two new cultivars- DeKalb CX232 and Spansoy 250, and one old cultivar – Hardin)

Growth Measurements

- Triweekly
  - Plant density
  - Leaf area index
  - Lodging
  - Height
  - Biomass (leaf, stem, pod, and seed proportions)
  - Pod and seed counts
  - Growth and reproductive stages (V & R stage)

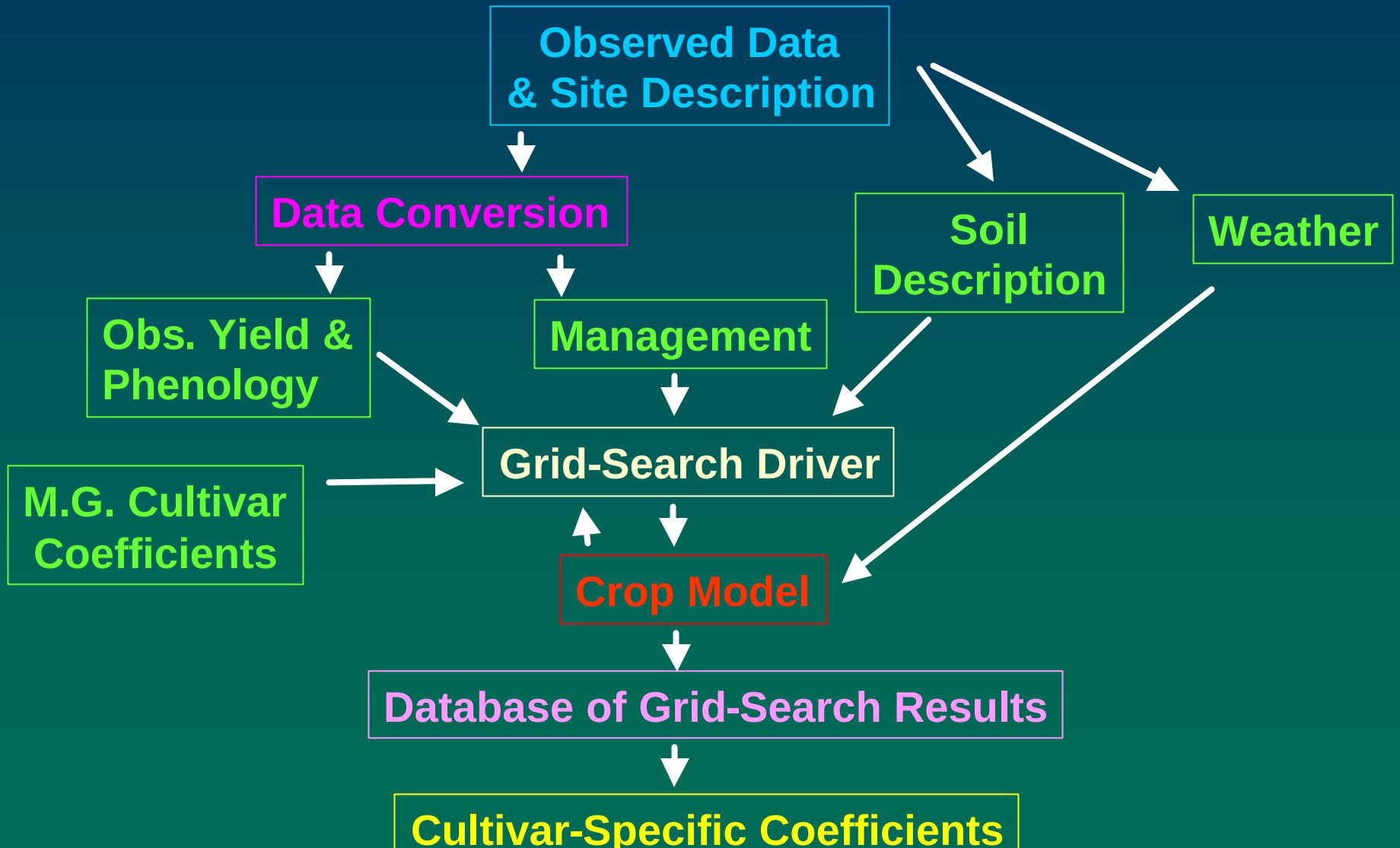
Environmental Measurements

- Triweekly
  - Soil moisture
    - (0-15, 15-30, 30-60, and 60-90 cm)
- Daily
  - Solar radiation
  - Precipitation
  - Soil temperature
  - Air temperature

CROPGRO – Soybean Model

"A mechanistic crop growth model that predicts daily photosynthesis, growth, and partitioning in response to daily weather inputs, soil traits, crop management, and genetic traits"

CROPGRO-Model



Observed vs. Simulated Phenology

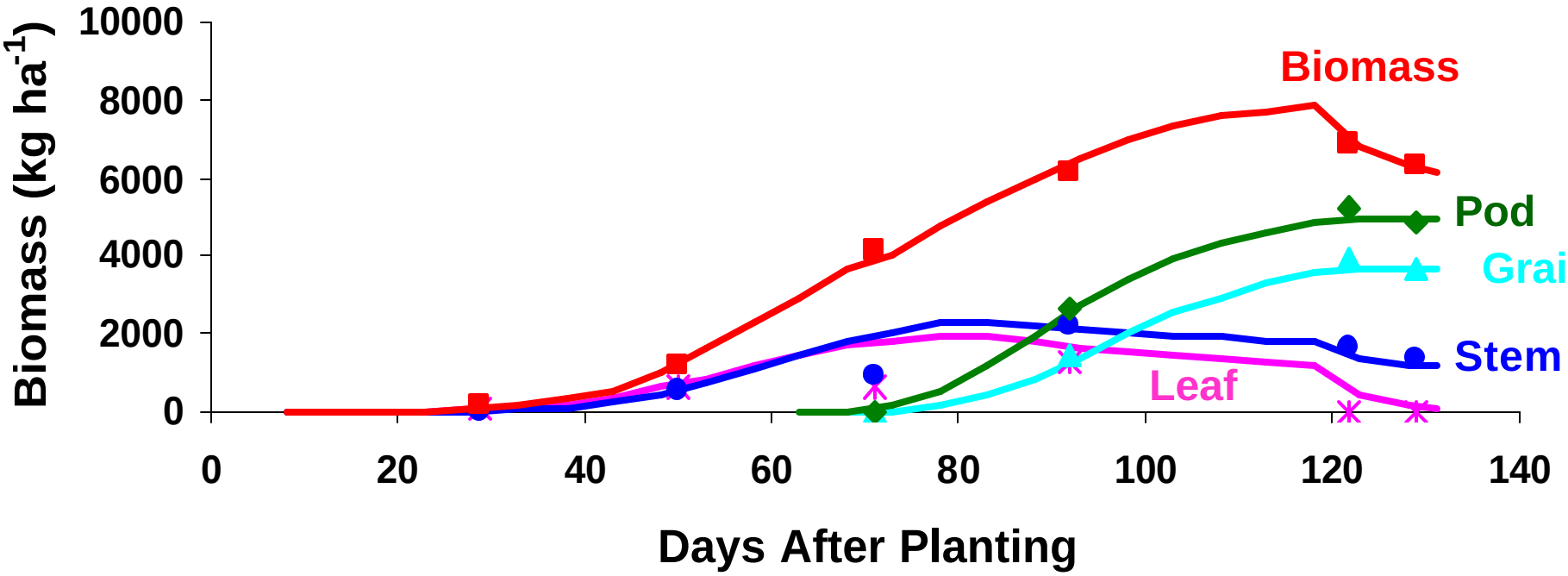
Cultivar	MG	R1	R3	R5	R7
		----------Days----------			
Hardin	1.9	48.79	66.13	72.02	107.68
		48.77	65.91	73.00	107.88
CX232	2.3	49.18	72.01	78.33	111.15
		49.27	72.33	78.02	111.38
Spansoy 250	2.5	50.44	70.22	78.44	113.94
		49.94	69.83	77.79	112.74

Simulated Yields Across 34 Management Systems

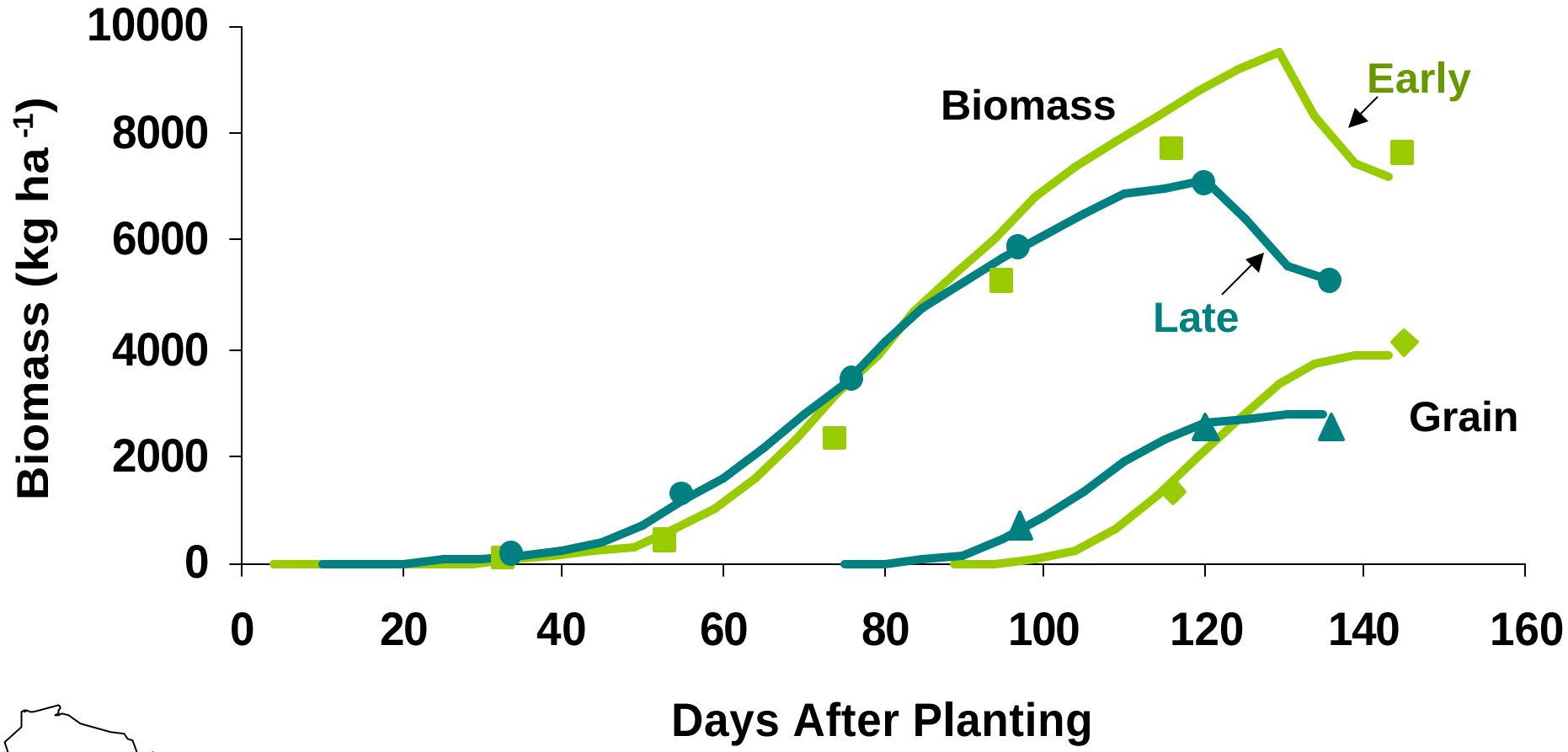
	Hardin	CX232	Spansoy	LSD (0.05)
Pod yield (kg ha^{-1})	4991	5176	5036	134
Seed yield (kg ha^{-1})	3818	3887	3799	NS
Weight per seed (g;dry)	0.14	0.15	0.13	0.2
Seed no. (per m^2)	2805	2655	2979	281
Seeds per pod	2.3	2.5	2.6	0.2
Max LAI (m^2 m^{-2})	5.3	5.8	5.7	0.3
Biomass at R8 (kg ha^{-1})	6398	6876	7121	412
Seed HI (kg kg^{-1})	0.60	0.56	0.53	0.02

UW MADISON AGRONOMY

1998 CX232 (Arlington, Late, CT)

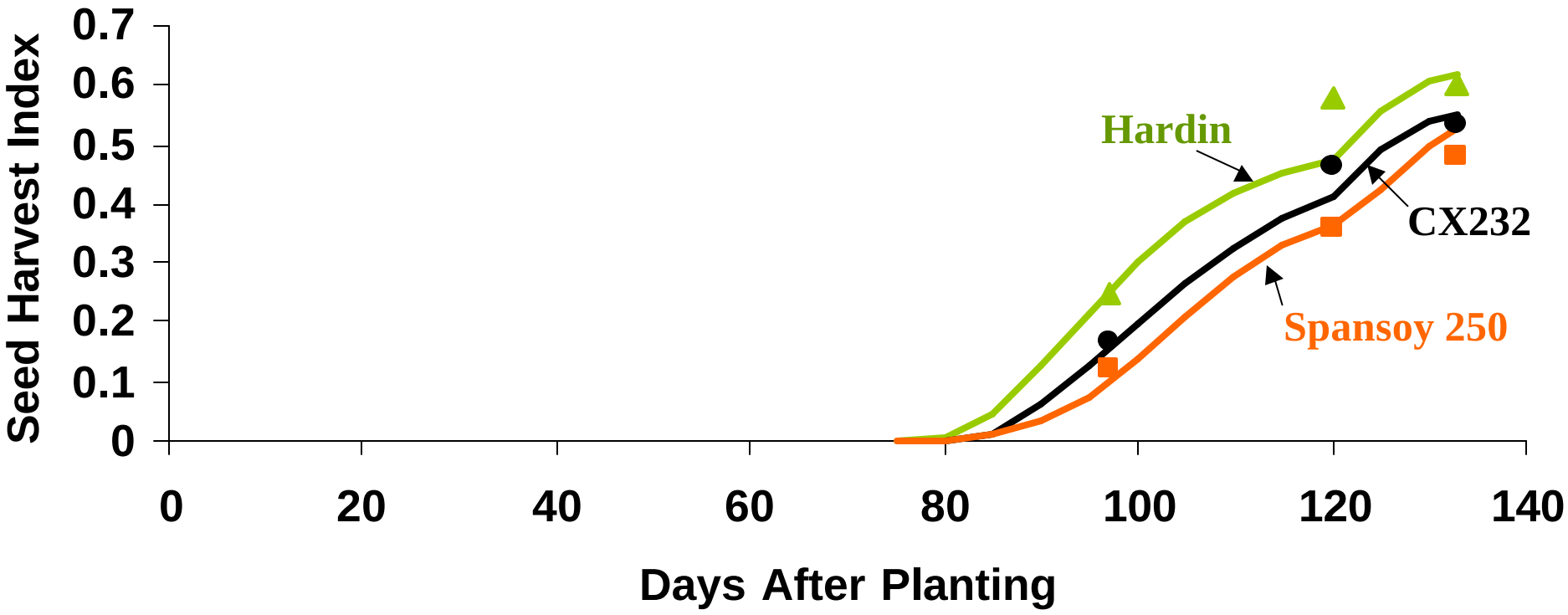


Spansoy 250, 2000 - Biomass and Grain Yield (Early vs. Late Planting)

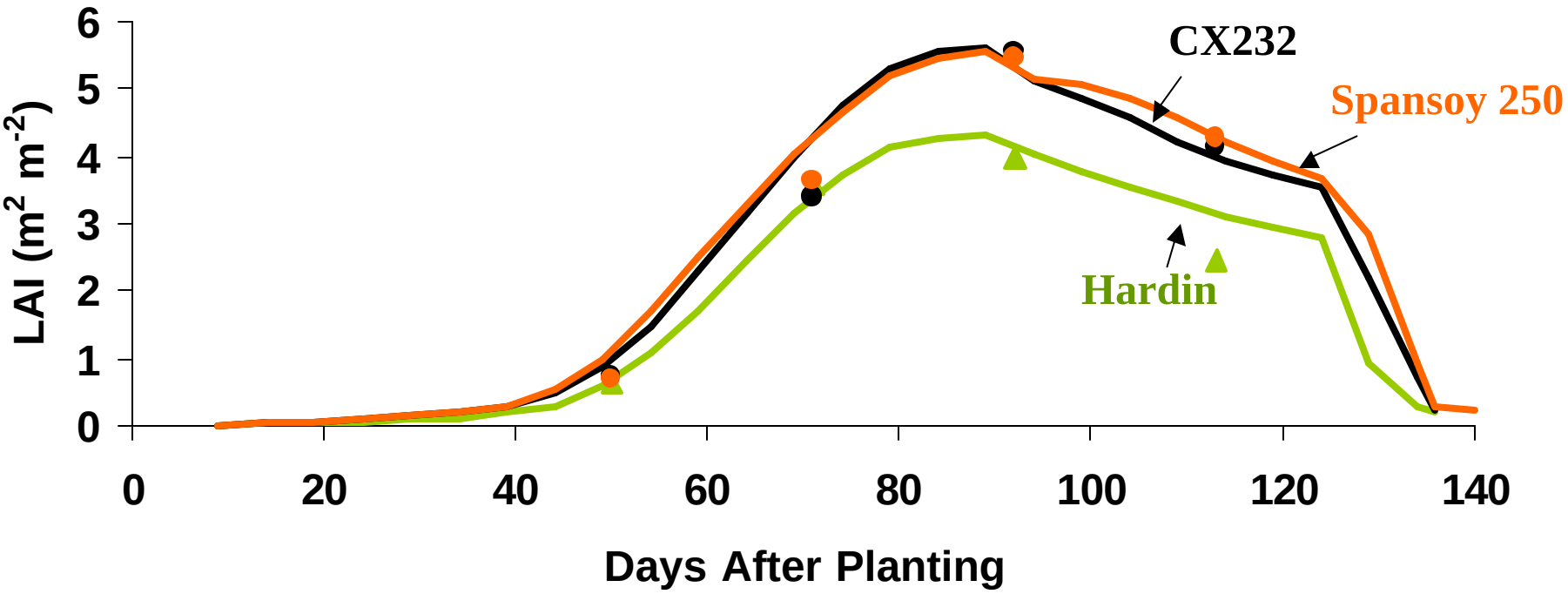


UW MADISON AGRONOMY

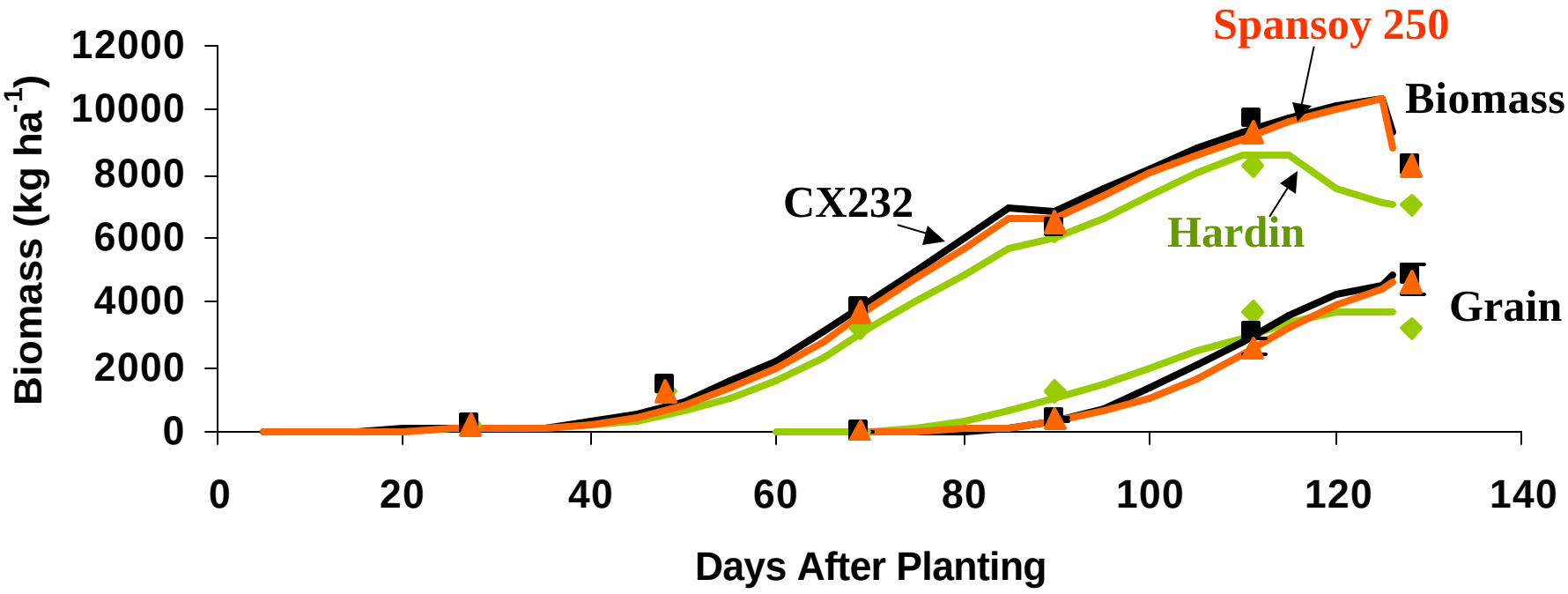
Seed HI - 2000 (Late, CT, Irrigated)



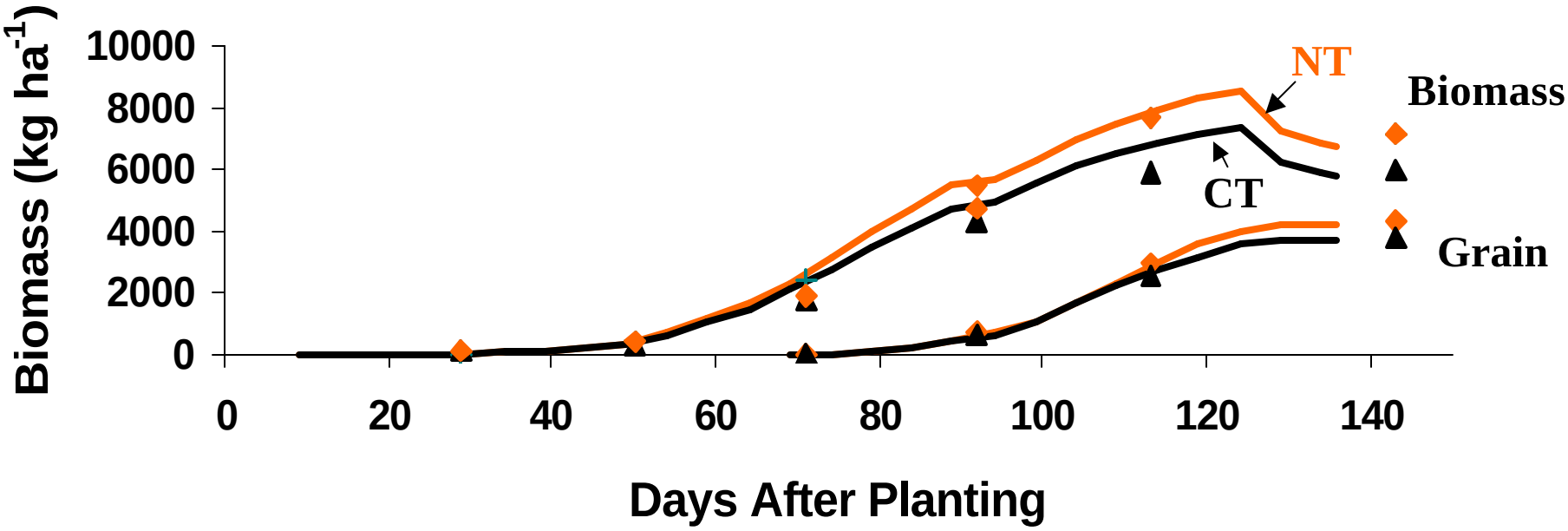
LAI 1998 (Early, CT)



Biomass and Grain Yield, Sandy 1998



CX232 Biomass and Grain Yield, 1999 (CT vs. NT)



Summary

- **CROPGRO-Soybean model could be used to quantify attainable soybean yields for the three cultivars in different management systems**
- **Simulated yield responses for the three cultivars were variable and ranged from 39 to 85 bu acre^{-1} across years and management systems**

Summary

- New soybean cultivars for the Upper Midwest are associated with traits of:
  - Higher total canopy biomass and LAI
  - Lower seed harvest index
  - More seeds per pod
  - Higher leaf photosynthesis
  - Longer seed fill duration and pod addition

Acknowledgements

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