

The West African TPE for grain sorghum: Varietal fit to agro-ecological zones



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- Largely based on thesis by Mamoutou KOURESSY
- Same modelling tools as HEINEMANN study for Brazil
- ...but no TPE cluster analysis
- Emphasis on agro-ecological fit of plant types
- Direct link with local breeding program









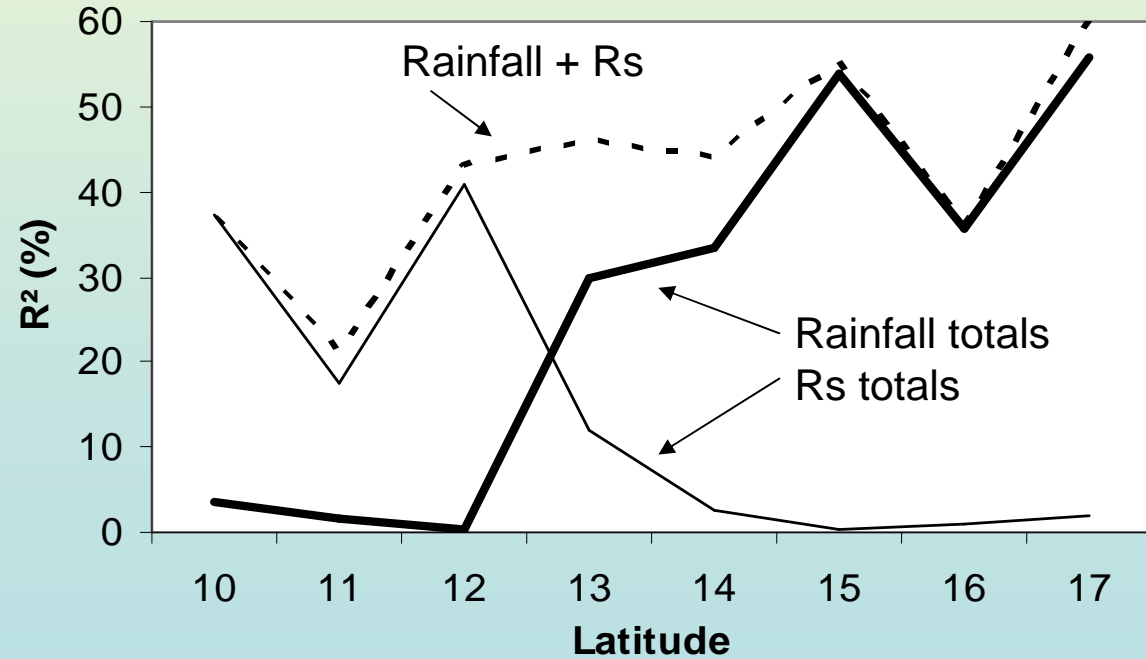
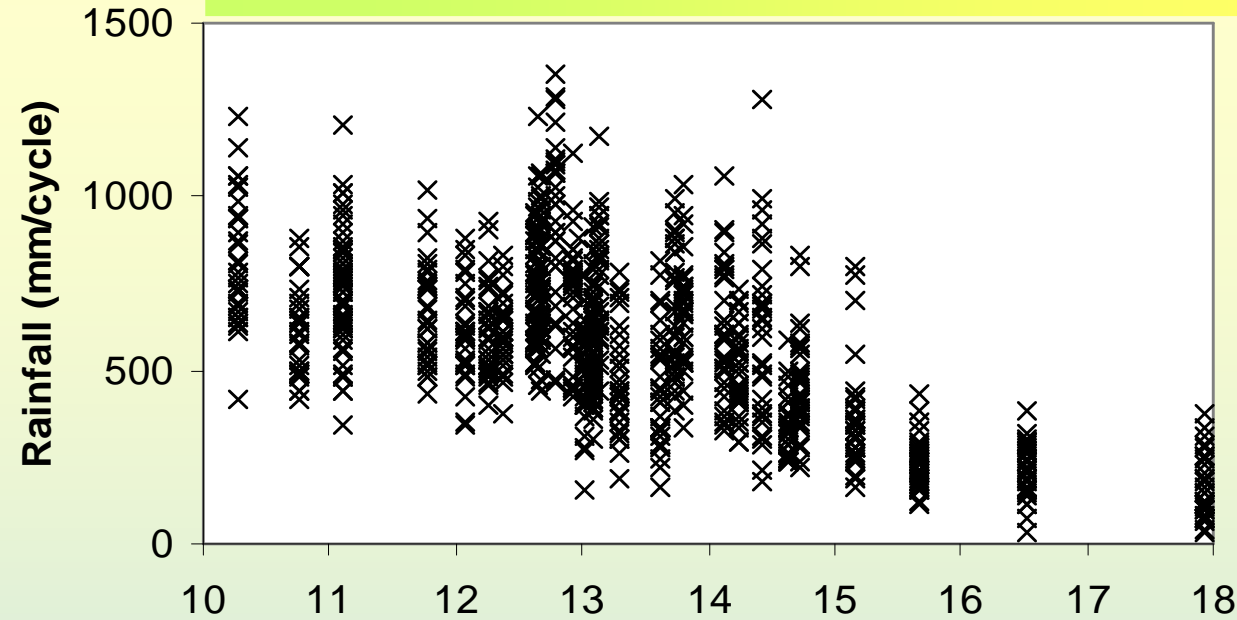
1. Characterization of N-S gradients of water limitation

SARRAH, long-term historical weather
records, fixed-duration variety

Characterization of N-S rainfall gradient in semi-arid West Africa:

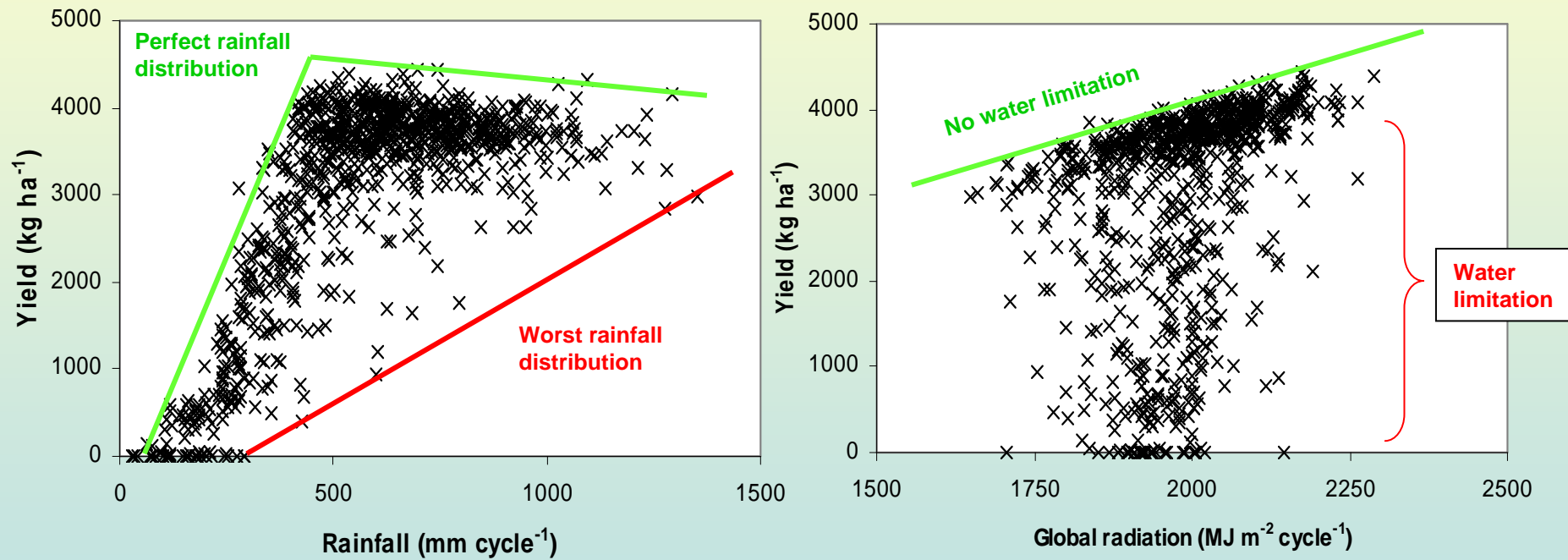
Water-limited (« attainable ») yield of a 100-d « modern » variety

Guinea Savannah Sudan Savannah Sahel Sahara



Problem of rainfall distribution within season

27 sites x 31 years across semi-arid West Africa



2. Taking into account phenological escape mechanisms (PP sensitivity)

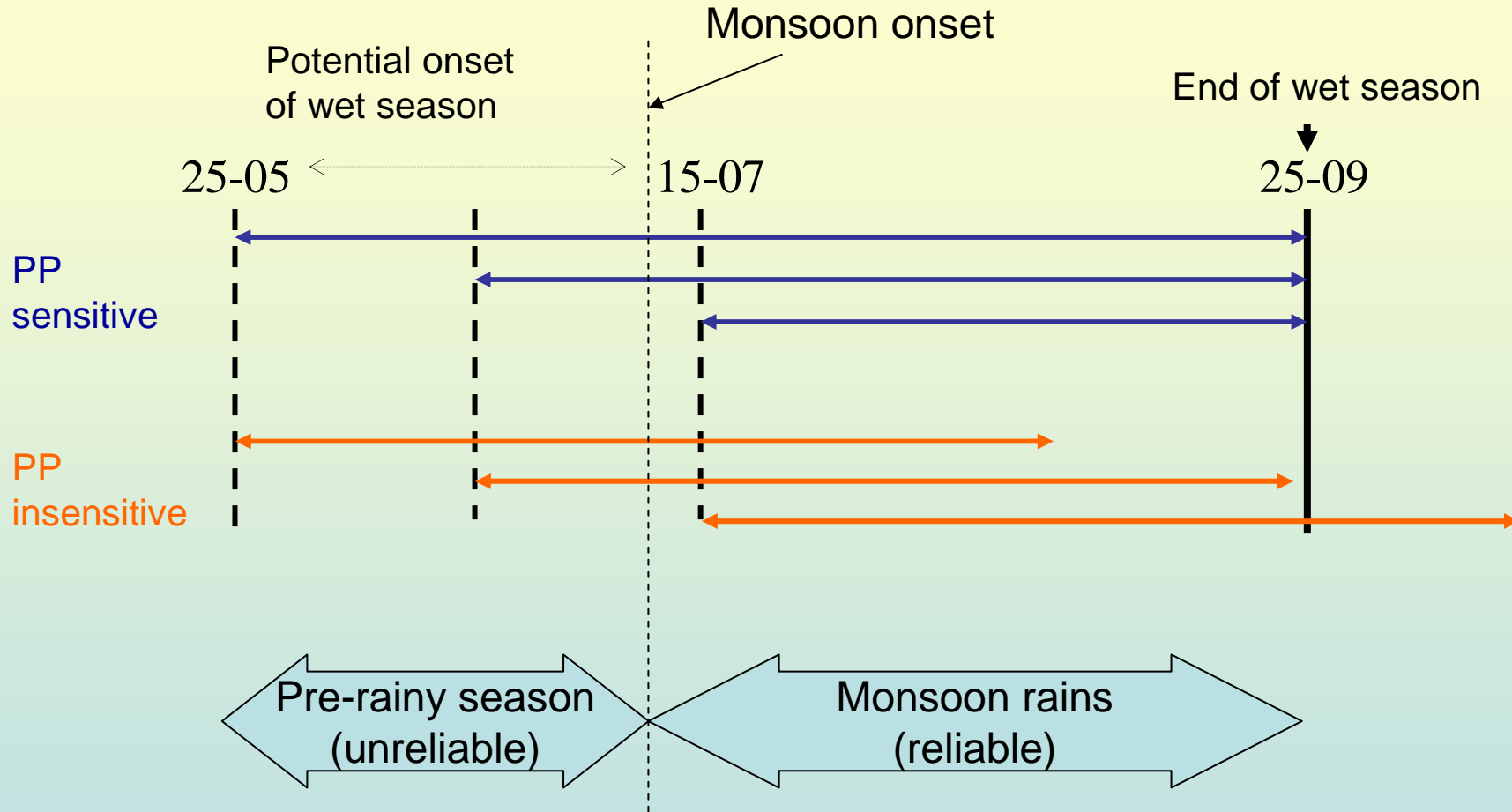
3 reference genotypes:

- V1 (Tall-traditional, PP-sensitive, low-yielding Guinea type)
- V2 (Improved dwarf, PP-sensitive, mainly Guinea inbred line)
- V3 (Caudatum grain hybrid, dwarf, staygreen, mildly PP-sensitive)

3 agro-ecological zones studied:

- Sikasso (Guinea savannah, long rainy season)
- Bamako (intermediate)
- Narra (Sahel, short rainy season)

Adaptive Value of Sorghum Photoperiodism

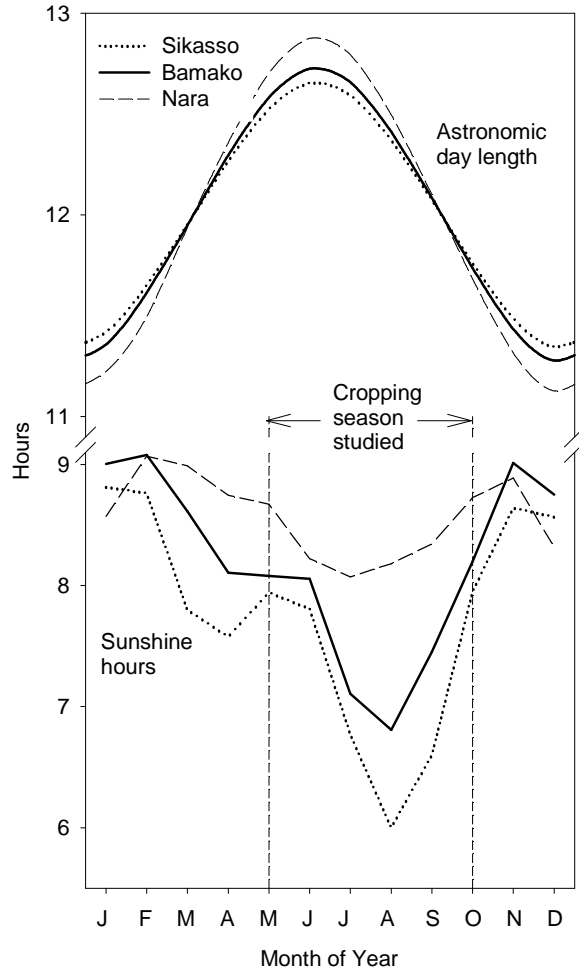


Need to flower at end of wet season:

- If late: Terminal drought
- If early: Stem & panicle rot, birds

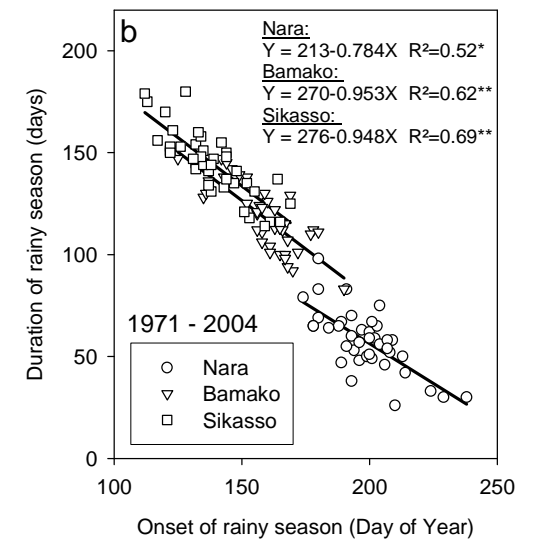
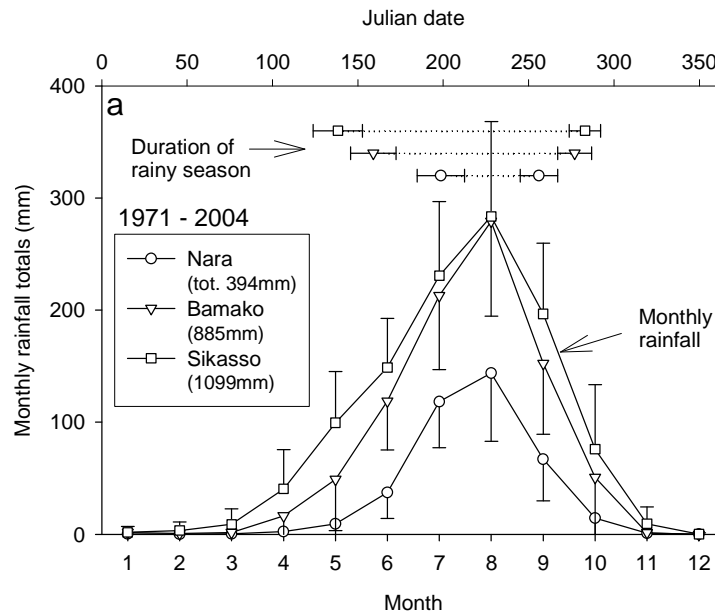
Agroecological zones studied

Sikasso: South Mali, savannah (long season)
 Bamako: Intermediate
 Nara: North Mali, Sahel (short season)

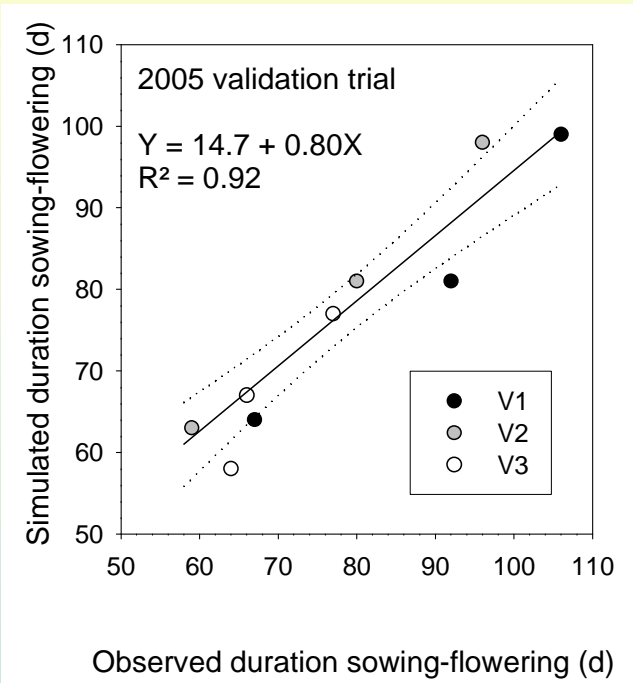
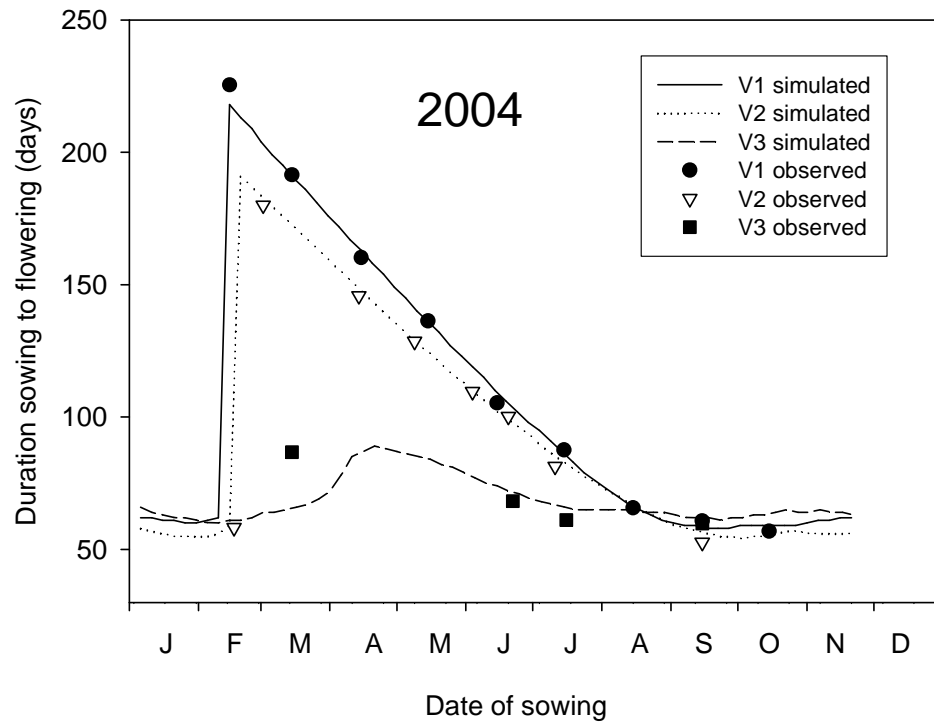


Duration and intensity of rainy season

Day length and sunshine hours



Calibration and validation of phenology model



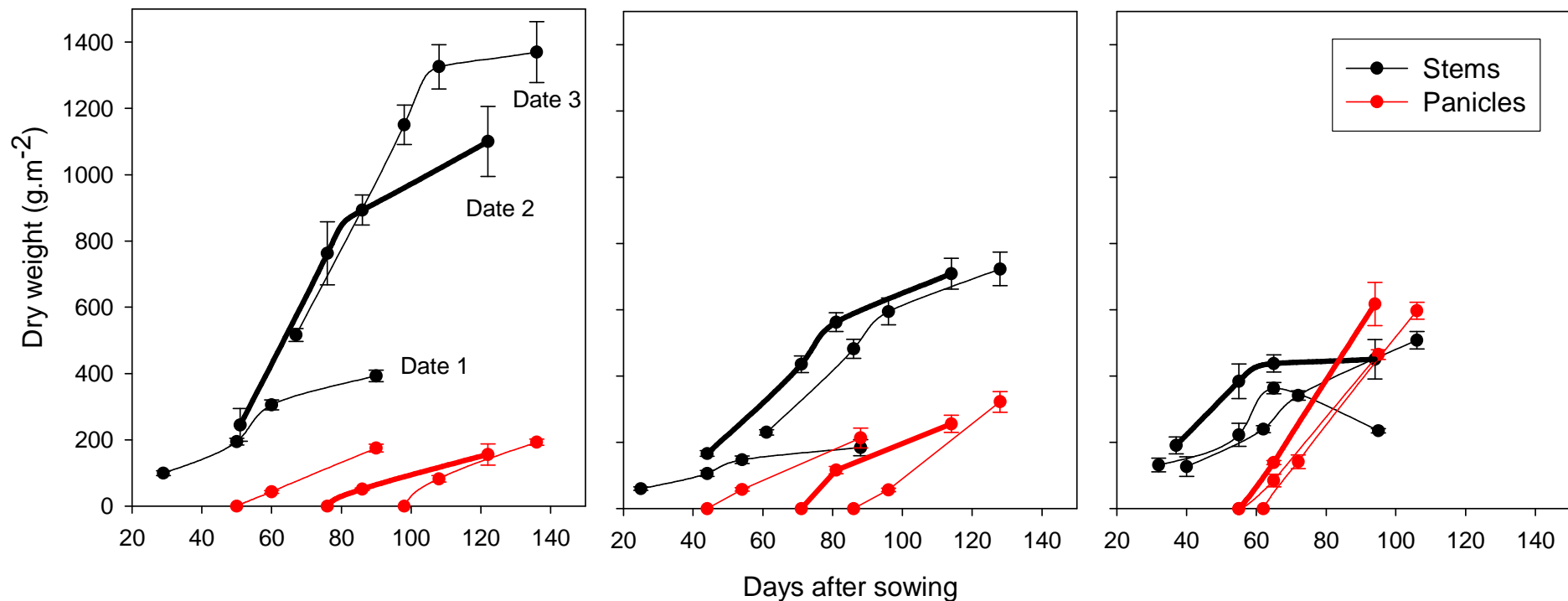
Cultivar	BVP	Pexp	Psens	Psat	Pbas
V1	416	0.09	0.50	13.5	11.0
V2	349	0.16	0.55	13.5	11.0
V3	472	0.10	0.75	13.5	11.0

Consequences of PP-sensitivity for biomass production and partitioning

V1 Trad., PP-sensitive

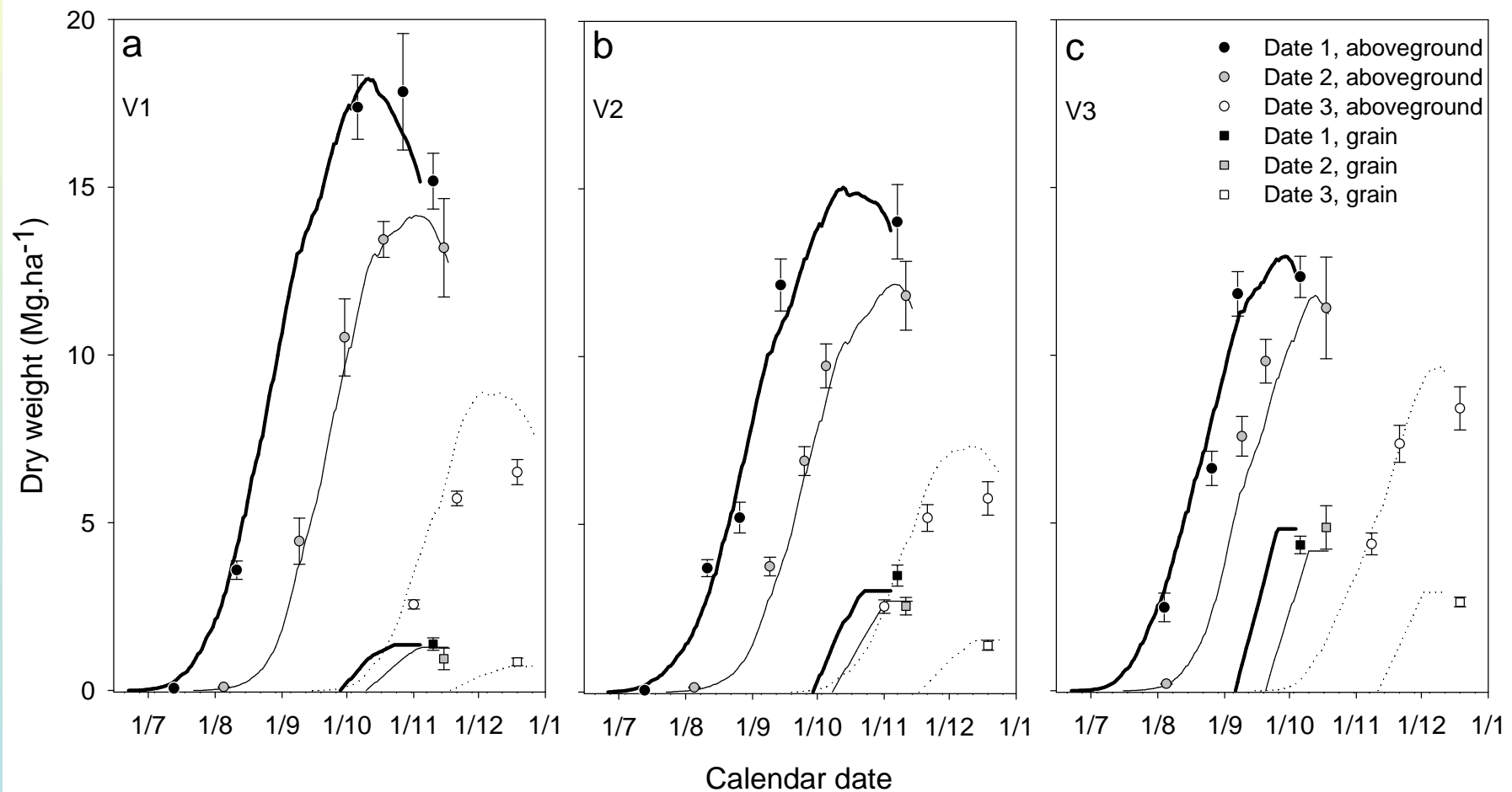
V2, Dwarf PP-sensitive

V3, Hybrid PP-insensitive



3. Integration of phenological and physiological components of adaptation

Implementation phenology model (*Impatience*) in a crop model (SARRAH)



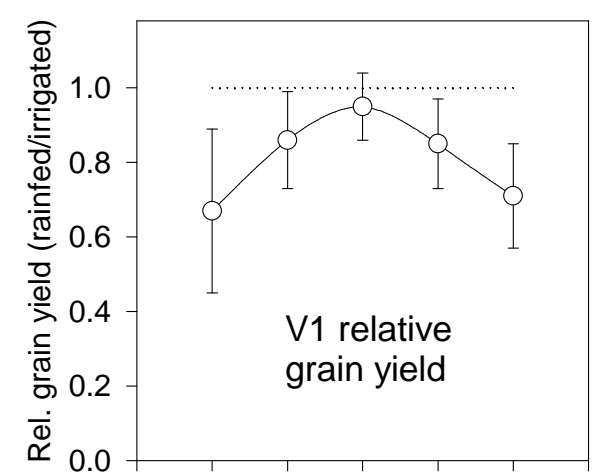
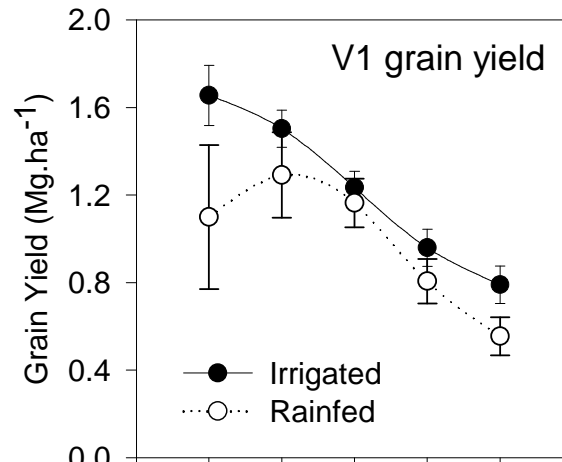
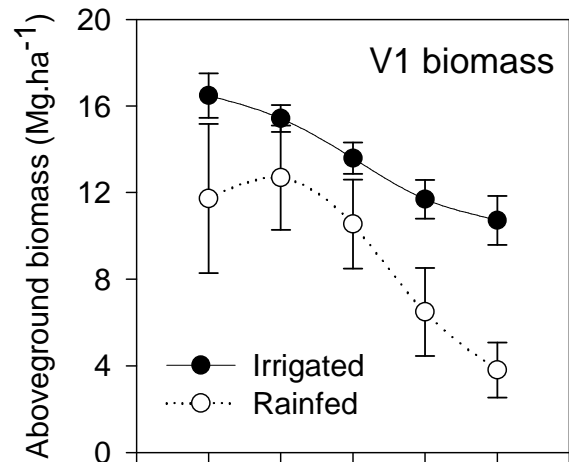
Attainable yields for Bamako, 1971-2004

AG-biomass

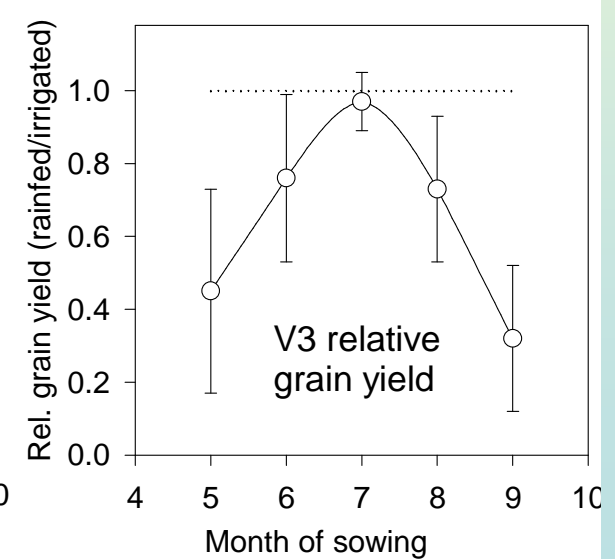
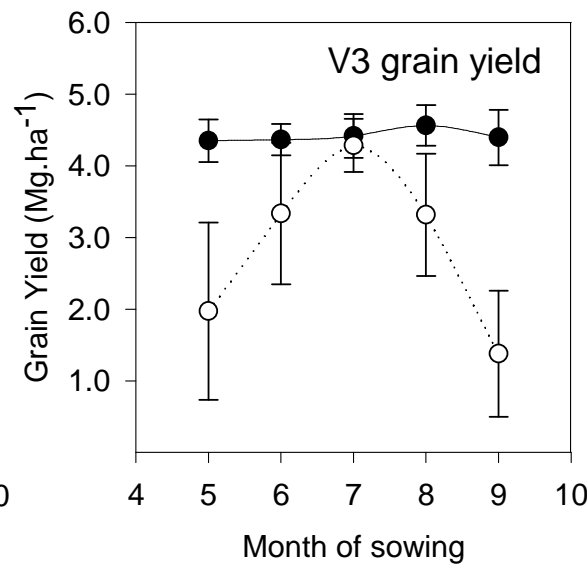
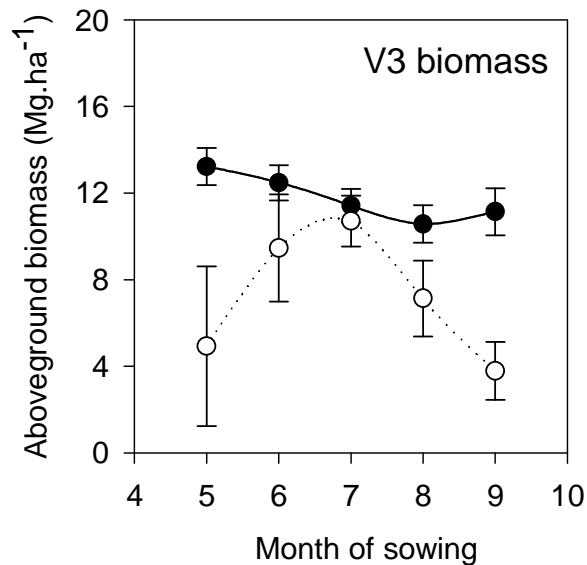
Grain yield

Rel.GY (att./pot.)

V1, Traditional



V3, Hybrid



4. Simplified integration of some agronomic and biotic constraints

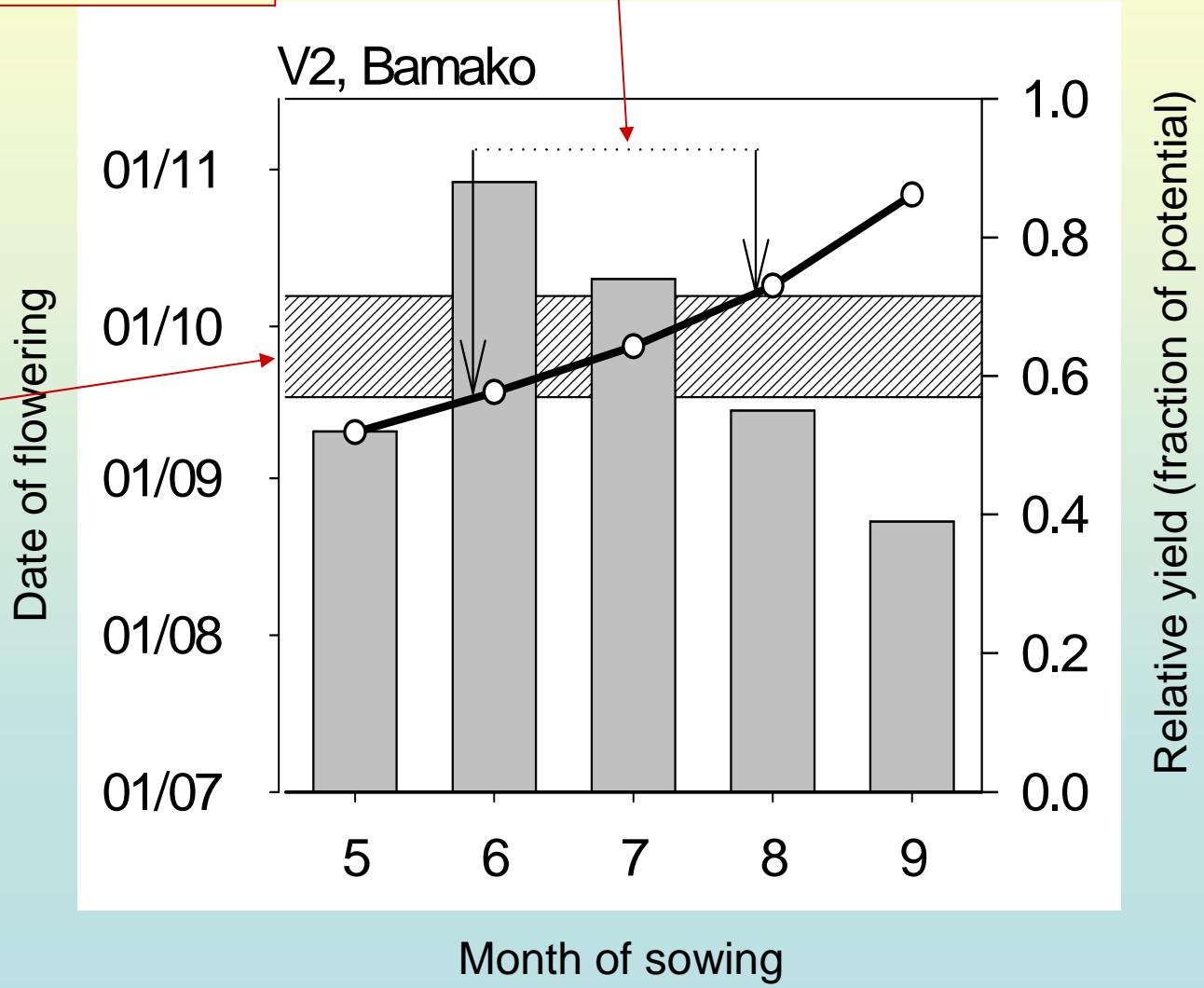
- Avoid excessively late sowing (Nitrate leaching, weed competition)
- Avoid too early flowering (grain pests & diseases associated with humid conditions)
- Avoid late flowering (terminal drought, bird damage)
- On this basis, achieve greatest possible flexibility of crop calendars

Criteria for agro-ecological fit:

- Yield reduction by drought (rel. Yield)
- Flowering at end of rainy season
- Flexibility of sowing date
- Possibility to sow early in season

« authorized » window for sowing

« authorized » window for flowering



Agro-ecological fit of cultivars

**400 mm
(Sahel)**

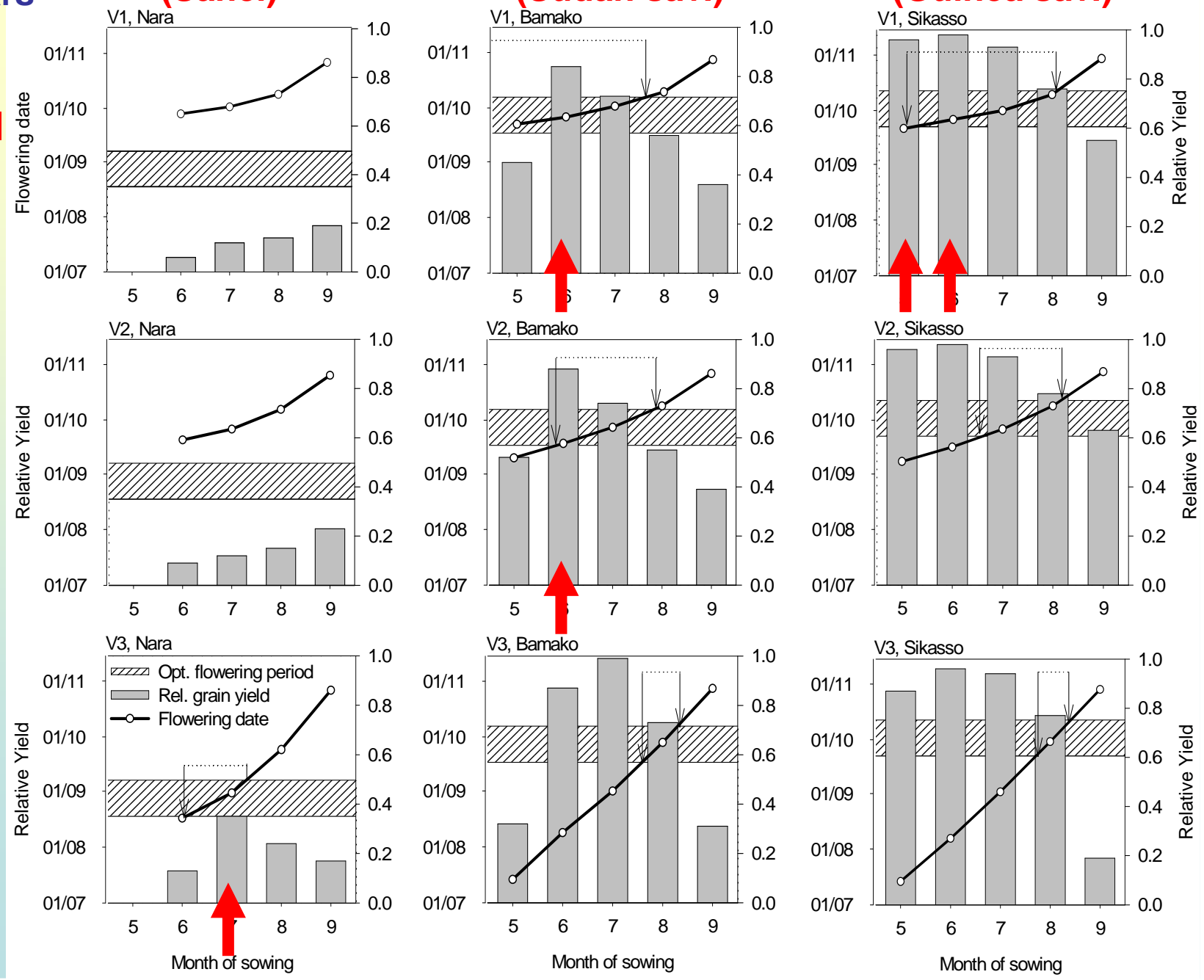
**800 mm
(Sudan sav.)**

**1100 mm
(Guinea sav.)**

Traditional

Improved

Hybrid



Conclusion

- PP-sensitivity essential in South (long rainy season)
- Modern, PP-insensitive types adapted only to North (short rainy season)
- Fine tuning of phenology according to latitude & climate
- Terminal drought tolerance important because end date of rainy season is variable (stay-green?)
- Major challenge: combine high GY with PP-sensitivity