

COMMERCIAL BIOSYNTHESIS AMINO ACIDS BYPRODUCTS ARE A SUITABLE REPLACEMENT FOR SYNTHETIC N FERTILIZERS IN CORN PRODUCTION

J.C. QUEZADA, A.W. LENSSEN AND K.J. MOORE
Department of Agronomy, Iowa State University

INTRODUCTION

- Iowa has a large commercial amino acid biosynthesis industry producing tryptophan (TRP) and lysine (LYS) that results in byproducts rich in organic and inorganic compounds.
- Nitrogen (N) content in these byproducts may have value as fertilizer N replacement in corn (*Zea mays* L.) production.
- Numerous studies on the use of biosynthesis byproducts have concluded that they are both potential sources of plant nutrients and beneficial soil amendments (Zhu et al., 1995; Martinez and Tabatabai, 1997).
- Most studies on amino acids and their biosynthesis byproduct amendments to crops have been done in controlled environments.
- Therefore we conducted a two-year field study where soil applied TRP, its biosynthesis byproduct and LYS byproduct were evaluated as fertilizer N replacements for corn production.
- The purpose of this study was to determine whether TRP or LYS biosynthesis byproducts could replace fertilizer N for corn production.

MATERIALS & METHODS

- Field trials were conducted during two consecutive growing seasons at three sites in central Iowa. Adjacent fields at the Iowa State University Sorenson Research Farm in 2013 (SF I) and 2014 (SF II), and 2014 Agricultural Engineering and Agronomy Research Farm (AF).
- Treatments supplied a total N rate of 196 kg N ha⁻¹. Details of the eight used treatments are in Table 1. The experimental layout was a randomized complete block design with four replicates.
- Individual plot size was 6.0 m long x 3.1 m wide with four corn rows per plot on 0.76-m row spacing. Cultural practices were appropriate for central Iowa.
- All measurements and calculations were done using published methodologies (Table 2) (Schepers et al., 1992; Markwell et al., 1995; Gitelson et al., 1996; Abendroth et al., 2011).



- Yield parameters and nitrogen and harvest indexes were calculated following the procedures of Dobermann (2005).



RESULTS

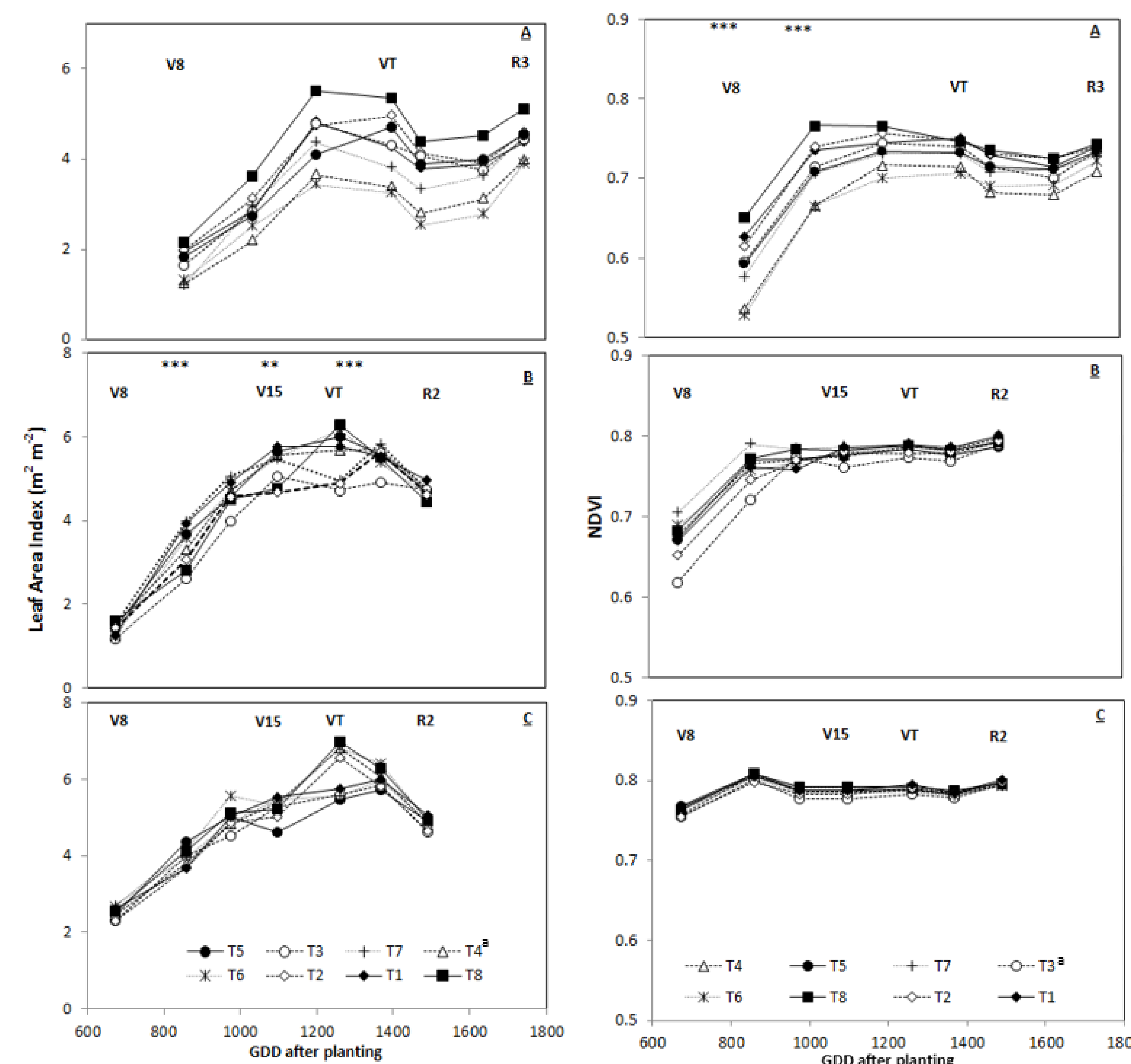
Table 1. Composition of eight iso-nitrogenous treatments

Treatment	Formulation	TRP	TRP		Ammonium Nitrate	Ammonium Sulfate
			Byproduct	Byproduct		
						kg N ha ⁻¹
T1	Dry	0	0	0	196	0
T2	Dry	14	0	0	182	0
T3	Dry	26	0	0	170	0
T4	Dry	56	0	0	140	0
T5	Liquid	0	196	0	0	0
T6	Liquid	0	98	98	0	0
T7	Liquid	0	48	148	0	0
T8	Dry	0	0	0	0	196

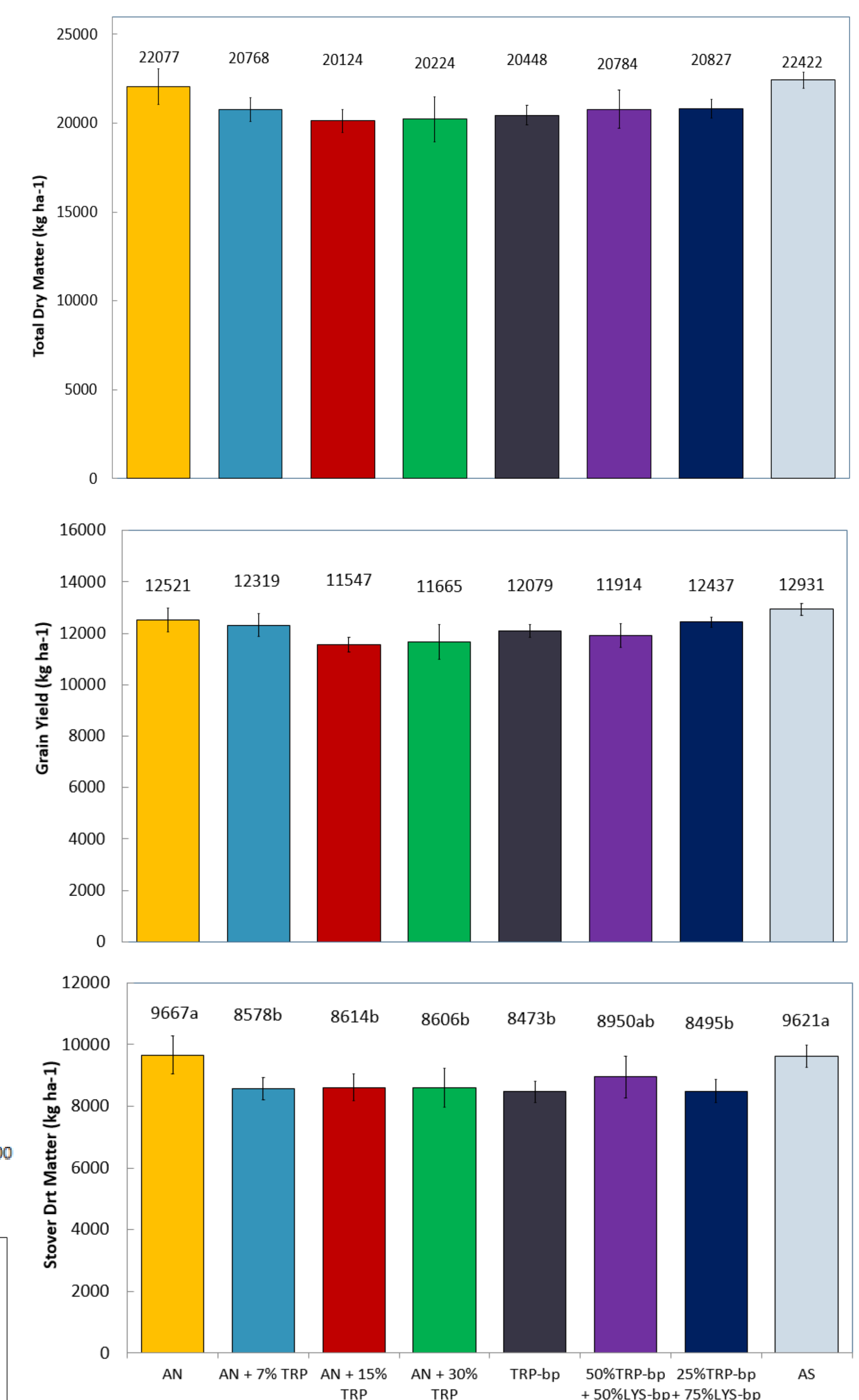
Table 2. Parameters measured during the study

Parameter	Stage for Measurements	Equipment / Method Utilized
Phenological Development	V8 – R5	Collar Method
Chlorophyll readings (SPAD)	V8 – R5	SPAD-502 Meter (Konica Minolta, Osaka, Japan)
Leaf Area Index (LAI)	V8 – R5	Decagon AccuPAR (Decagon Devices Inc., Pullman, WA)
Normalized Difference Vegetative Index (NDVI)	V8 – R5	Crop Circle ACS-210 Active Canopy Sensor (Holland Scientific, Lincoln, NE)
Corn Biomass and Yield Components	R6	Dobermann, 2005
Corn Grain Yield	2 weeks after R6	Dobermann, 2005
Grain Quality	2 weeks after R6	NIRS

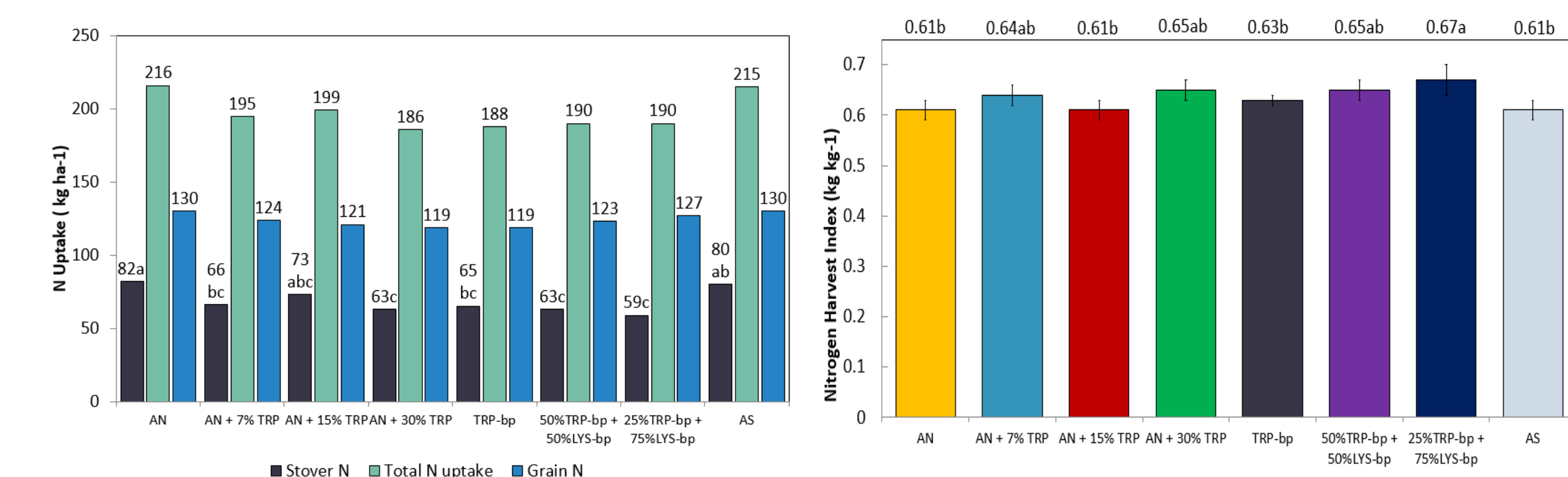
Figs. 1 & 2. LAI & NDVI as a function of N treatments, during corn growth stages ranging from V8 to R3. At (A) SF I; (B) SF II and (C) AF near Ames, IA. Asterisks indicate significant differences for a sampling date among N treatments ($P=0.05$).



Figs. 3, 4, & 5. Total dry matter, grain yield & stover yield



Figs. 6 & 7. N uptake & Nitrogen Harvest Index (NHI).



DISCUSSION & CONCLUSIONS

- Corn growth parameters performed similarly when N was provided either by amino acid biosynthesis byproducts or N fertilizers (Figs. 1 & 2).
- Corn grain yields and total dry matter produced with biosynthesis byproducts N was similar to those obtained from commercial N fertilizers (Figs. 3 & 4).
- There was a decrease in corn stover production with biosynthesis byproducts (Fig. 6). This might allow for decreased fall tillage in high-yielding environments.
- The NHI increased when biosynthesis byproducts were applied (Fig. 7). This may be due to the influence of biosynthesis byproducts on hormone concentrations or other secondary metabolites driving N allocation in corn.
- The TRP and LYS biosynthesis byproducts are suitable replacements of N fertilizers for corn production.