Closing Yield Gaps in Corn and Soybean: Impact of Different Management Practices

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Introduction

Yield gap, potential minus on-farm yields, is primarily defined by management practices (M) and their interactions with the environment (E). By selecting best management practices farmers can close on-farm yield gaps.

Objective

Study the contribution of varying farming systems in developing efficient and high-yielding (yield and nutrient uptake) systems in corn-soybean cropping rotations.

Materials and Methods

Four site-years of research, two each corn and soybean, were conducted under full irrigation at Scandia (Kansas) during 2014 and 2015 growing seasons. The trial design was randomized complete block with five treatments and five replications per crop.

	(-) Intensification (+)				
Treatments	**CP**	**CF**	**PI**	**EI**	**AD**
Seeding rate (S/C)	274k/74k	274k/74k	429k/89k	429k/89k	429k/89k
Row spacing (m)	0.76	0.76	0.38	0.38	0.38
Fertilization S/C	No P-K (56N)*	P-K (56N)*	No P-K (56N)*	P-K (56N+112N)*	P-K (56N+112N)*
Micronutrients (Zn-B-Fe)	No	No	No	1x	2x
Fungicide	No	No	No	1x	2x
Insecticide	No	No	No	1x	2x

CP=Common practices, **CF**= comprehensive fertilization, **PI**= production intensity, **EI**= ecological intensification (**CF+PI**), **AD**= advanced plus. *Fertilizer N only applied in the corn study. S: Soybean. C: Corn.

Plant growth, canopy coverage, nutrient concentration, and yield components were determined in all site-years. Seasonal biomass and nutrient content patterns were synthesized from nine sampling times throughout crop growing season.

Results

- Soybean grain yield for **EI** and **AD** was significantly different compared with **CP** and **CF** for both 2014 and 2015 seasons. There were no significant differences in corn yields (average 14.5 Mg ha^{-1}) among the systems for the 2014 season (**Fig. 1**).

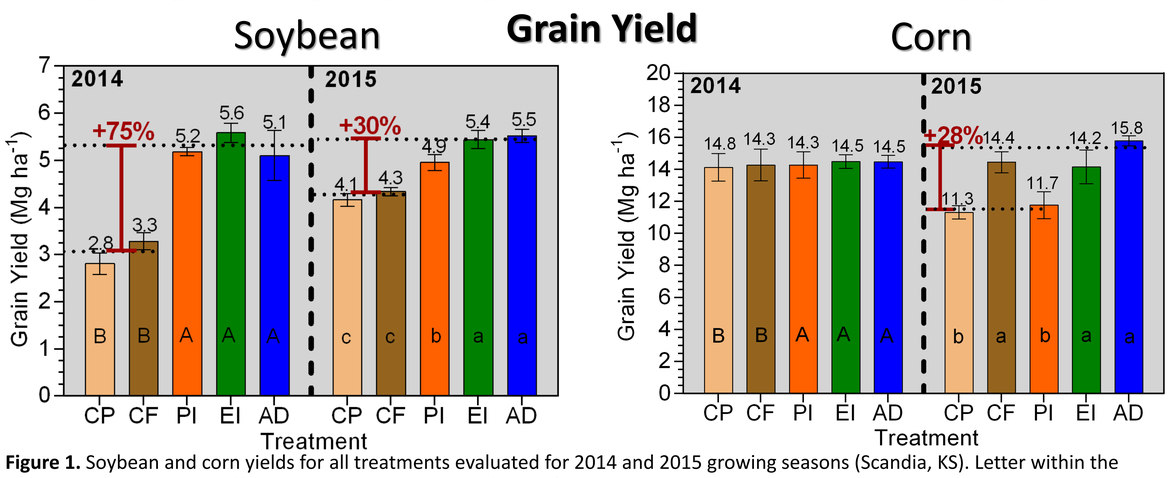

Figure 1. Soybean and corn yields for all treatments evaluated for 2014 and 2015 growing seasons (Scandia, KS). Letter within the bars indicates statistical difference between treatments ($p<0.05$).

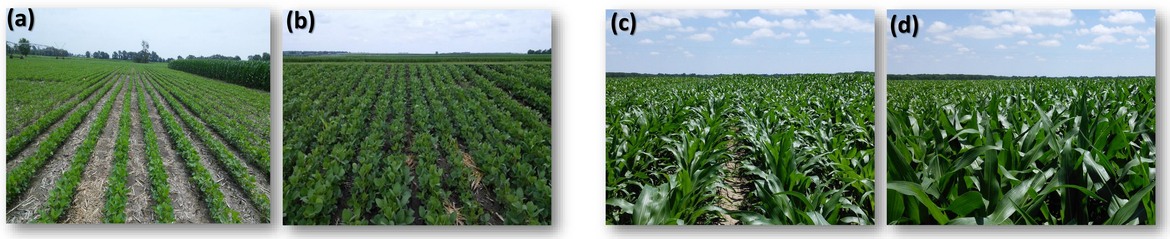

Figure 2. Field view at vegetative stage in soybean (V4) and corn (V10): for **CP** (a,c; 0.76 m) and **EI** (b,d; 0.38 m), Scandia, KS (2014).

Results (continued)

- Canopy coverage differences in vegetative stages were greater in soybean than corn for **CP** and **EI** (**Figs. 2, 3**).

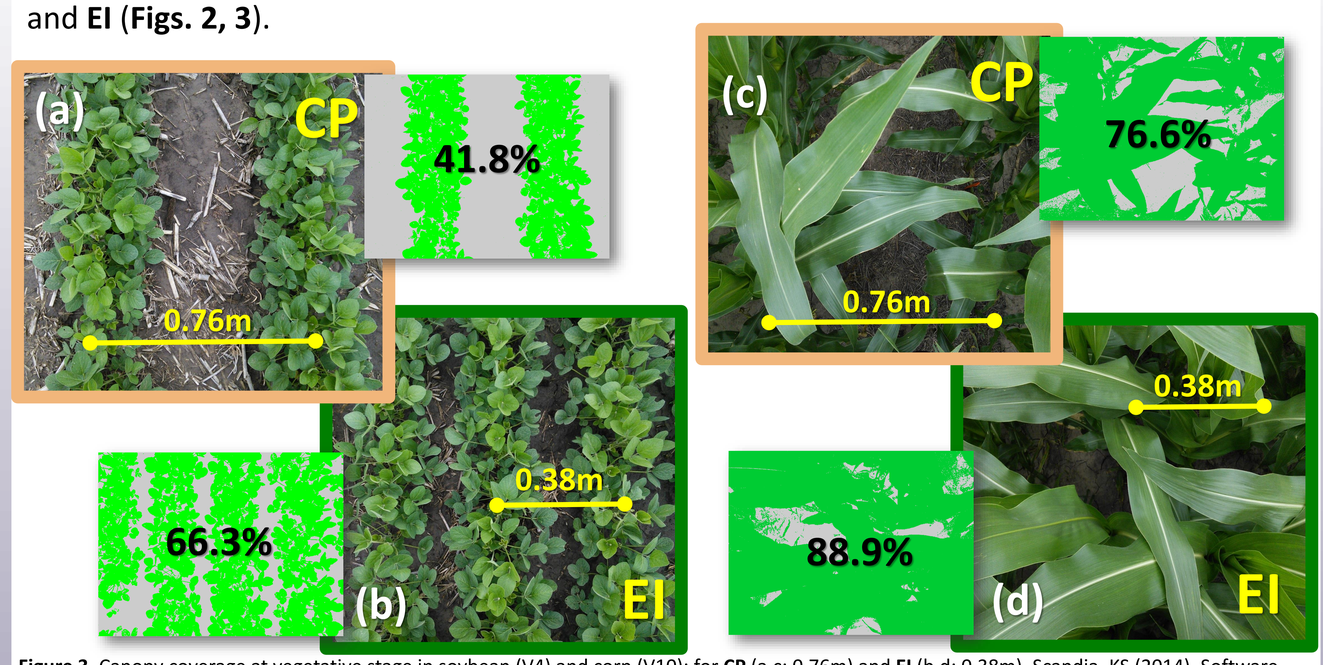

Figure 3. Canopy coverage at vegetative stage in soybean (V4) and corn (V10): for **CP** (a,c; 0.76m) and **EI** (b,d; 0.38m), Scandia, KS (2014). Software for imagery analysis: Siscob®.

- For soybeans, **EI** system showed 76% higher plant nitrogen (N) uptake relative to **CP (Fig. 4)**. Total N allocated to the grain fraction was 10% higher for **EI** relative to **CP** treatment.
- For corn, total N uptake was similar for both systems (**Fig. 4**), which followed the yield pattern portrayed for both **EI** and **CP** treatments (**Fig. 1**).

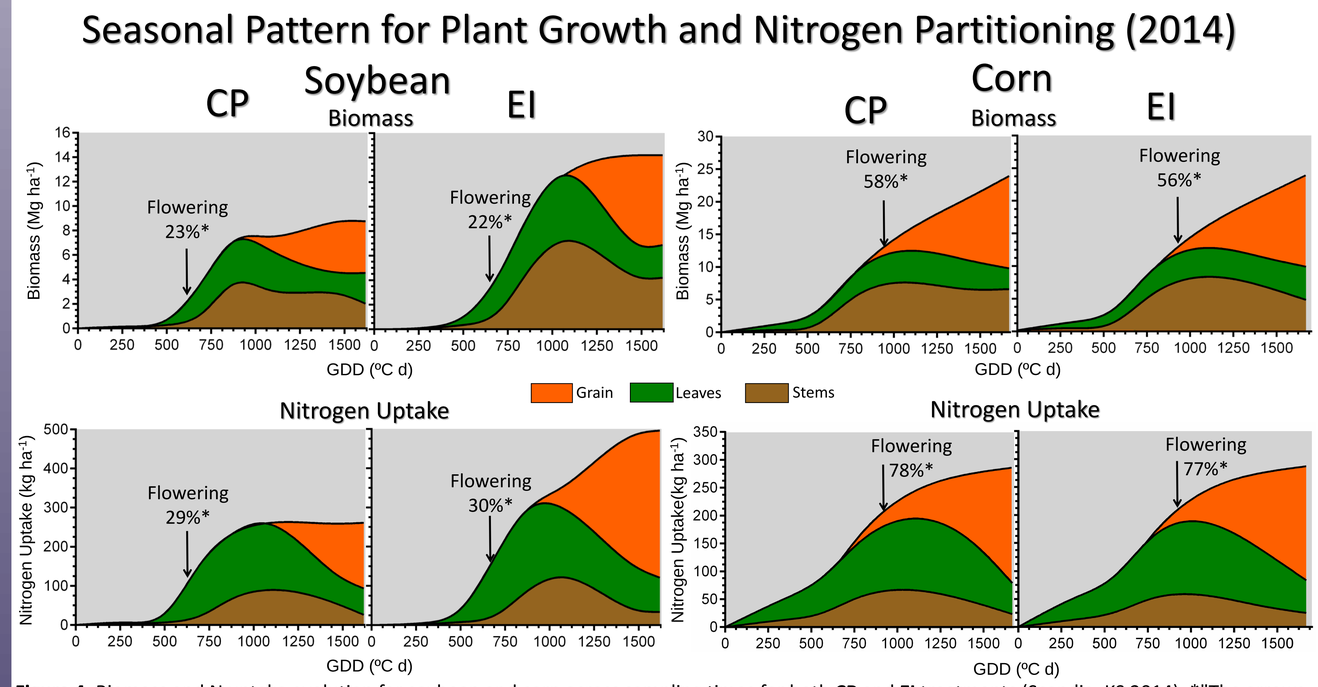

Figure 4. Biomass and N uptake evolution for soybean and corn across sampling times for both **CP** and **EI** treatments (Scandia, KS 2014). *"The arrows on each panel indicate the average flowering time for each treatment and crop. Percentages are proportions of vegetative-stage biomass and N uptake relative to total accumulations at maturity."

- Total biomass at harvest for **EI** in soybeans was 62% greater than **CP (Fig. 4)**. For corn both treatments accumulated similar biomass at the end of the growing season.
- Grain N Harvest Index (GNHI) was 0.81 for **EI** and 0.73 for **CP** in soybeans. For corn, GNHI did not present statistical differences between all evaluated treatments (0.77).

Conclusions

- Larger yield gaps were detected in the soybean phase. Balancing nutrients under narrower row spacing and higher seeding rate produced the largest yield benefit.

- Further physiological analysis of following growing seasons will improve the understanding of long-term effects on the productivity and sustainability for the corn-soybean systems.