

# Agronomic Management Changes Canopy Yield Component Distribution in Soybean

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**Question:** Can yield of soybean be improved with agronomic management by targeting different regions of the soybean canopy?

**Objective:** Determine if modern agronomic management practices can alter yield component distribution within the soybean canopy.

## Introduction:

- Soybean (*Glycine max* (L.) Merr.) seed yield is comprised of yield components including pod number area<sup>-1</sup>, seed number pod<sup>-1</sup>, and individual seed weight. Agronomic management commonly used to improve yield is thought to influence multiple yield components simultaneously.
- While nodal variation for some yield components has been found, there is limited research which documents how modern agronomic management tools influence nodal yield distribution and seed development.
- Seed-filling and final seed weight, the relationship between cumulative photoassimilation and dry weight partitioning, is often expressed as a function of time:  $Effective\ Filling\ Period\ (EFP) = Seed-Filling\ Rate\ (SFR) \times Seed-Filling\ Duration\ (SFD)$ .
- Therefore, it is believed that appropriately timed agronomic management can also be used as a strategy to increase final seed weight at different canopy locations.

## Research approach:

- Two field experiments were planted at Champaign, IL (central) and Harrisburg, IL (southern) during 2015.
- Four agronomic factors were :
  - Variety:** 3.1 and 3.8 RM variety (Champaign); 4.8 and 5.3 RM variety (Harrisburg).
  - Fertilization regime:** Untreated control vs preplant banded phosphorus at 84 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> as Mosaic's MicroEssentials® SZ™ (12-40-0-10S-1Zn).
  - Foliar Protection:** Untreated control vs a foliar insecticide and fungicide applied at R3.
  - Plant Growth Regulators (PGR):** Megafol applied at V5 or Ascend at R2 or Utilize applied at R2. (Because responses to each PGR were similar, the results were averaged across PGR's.)
- Plots were planted to achieve an approximate final stand of 358,000 plants ha<sup>-1</sup> (145,000 plants Ac<sup>-1</sup>) in a split-plot experimental design with six replications.
- Five plants plot<sup>-1</sup> were sampled at R5 (beginning seed), late R6 (full seed), and R8 (full maturity).
- The number of pods and the number and weight of beans were determined using canopy region subsets: nodes 4 to 6 (bottom third of canopy), nodes 10 to 12 (middle third), and nodes 15 to 17 (upper third).
- EFP analysis is still in progress at the time of this presentation. Therefore, only data from final mature seeds are presented.

## Impact of Agronomic Management on Yield

- Foliar protection appeared to be an important factor for the 2015 growing season at Harrisburg, IL with a significant increase of 0.41 Mg ha<sup>-1</sup> (9%).
- At Harrisburg, yield increases resulted from the combination of fertility and foliar protection (+ 0.3 Mg ha<sup>-1</sup>, 6.5% increase) and the combination of fertility, foliar protection, and PGR (+ 0.32 Mg ha<sup>-1</sup>, 7% increase).

**Table 1.** Effect of agronomic management treatments on grain yield in Harrisburg, IL and Champaign, IL during the 2015 season. Grain yield is averaged across variety and presented at 13% moisture concentration.

Treatment	Harrisburg	Champaign
	Yield Mg ha <sup>-1</sup>	
Untreated	4.62	5.04
+ Fertility	4.63	5.24
+ Foliar Protection	5.03	5.04
+ Fertility & Foliar Protection	4.92	5.44
+ Plant Growth Regulator	4.69	4.98
+ Fertility, Foliar Protection, and PGRs	4.94	5.39
LSD P ≤ 0.10	0.14	0.14

- At the Champaign site, fertility combined with foliar protection caused the largest yield increase, 8% or 0.4 Mg ha<sup>-1</sup>.
- Also at Champaign, the combination of fertility, foliar protection, and PGRs caused a 7% increase of 0.35 Mg ha<sup>-1</sup>.
- Fertility responses were observed early in the season (Figure 1), which corresponded to a 0.2 Mg ha<sup>-1</sup> (4%) increase in yield.
- Although foliar protection did not increase yield when applied alone, it did have a synergistic effect when applied with fertility (+7%).
- The PGRs did not significantly increase or decrease yield at either location.



Figure 1. Early season growth response to fertilizer treatment observed in Champaign, IL.

## Yield Component Changes within the Soybean Canopy due to Agronomic Management

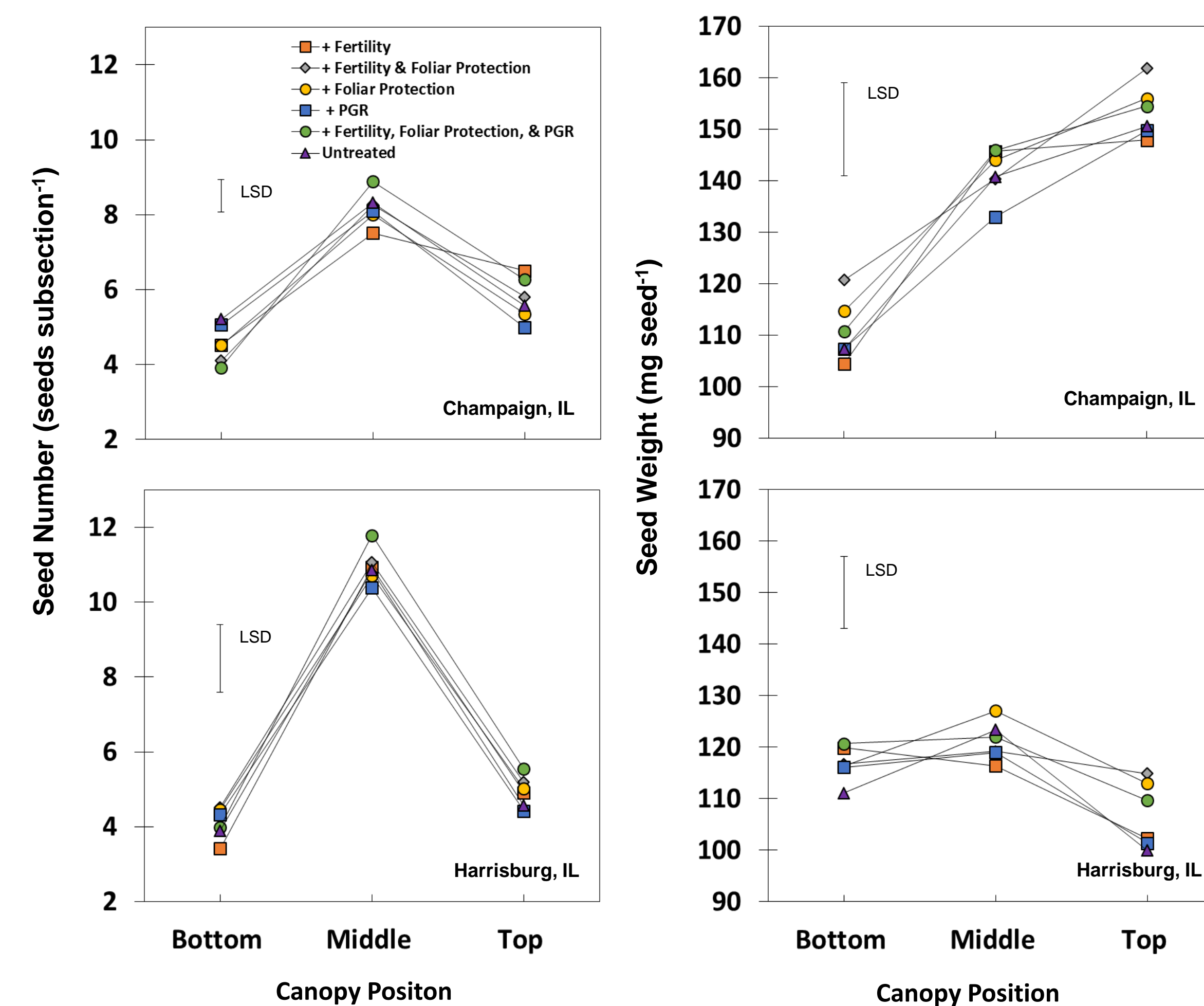


Figure 2. Effect of treatment on seed number and seed weight in each canopy region subsample of soybean measured at Champaign and Harrisburg, IL during 2015. Values were averaged across variety and presented at 0% moisture concentration. LSD significant at P ≤ 0.10.

- Across both locations, seed weight and seed number varied within the soybean canopy (Figure 2).
- Overall, nodes located in the middle canopy contained as much as 58% greater seed number than nodes positioned in the top or bottom regions.
- The distribution of seed weight within the canopy was location-dependent; however, the middle nodes typically exhibited the heaviest seed weight.
- Seed weight at the top nodes at Champaign was greater than the middle node seed weight (+8%), while at Harrisburg the seed weight of the top nodes was less than the middle nodes (-12%).

- Compared to the Harrisburg site, in which plants had more seeds at the middle section (+3 beans per subsection), plants grown in Champaign exhibited a slight increase in seed number at the bottom and top nodes.
- Seed weight at Harrisburg was generally less than Champaign at the middle and top canopy sections.
- The combination of increased seed number at the bottom and top nodes and an increase in seed weight may be the basis of the higher soybean yields seen at Champaign (Table 1).
- At Harrisburg, the yield increase from foliar protection, seen in Table 1, was due to the increase of seed weight at the top nodes.
- At Champaign, fertility and foliar protection yield responses were in result of increased seed weight at the bottom and top nodes.

## Agronomic Implications:

- Do canopy regions vary in their ability to generate yield?
  - ✓ Yes, the middle region of the soybean canopy was responsible for approximately 58% of final yield compared to the bottom and top regions.
- Can specific regions be targeted with agronomic management for a multifaceted approach to improved yield?
  - ✓ Yes, any treatment combination containing foliar protection increased seed weight in the top of the canopy. Fertility with foliar protection increased seed number at the middle and the top nodes.
- Does location have an impact on yield components within the soybean canopy?
  - ✓ Yes, an increase in seed weight at the middle and at top of the canopy in Champaign, IL (central) resulted in higher yields than the Harrisburg, IL (southern) location.