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Effect of Late Season Management Practices on Soybean Seed Filling and Yield

F.E. Baronio and I.A. Ciampitti

Introduction

For soybean (*Glycine max* [L.] Merr.), final seed yield is primarily explained by modifications in the seed number per unit area. However, changes in individual seed weight can contribute to variations in seed yield. Final seed weight is defined by the amount of biomass accumulated in seeds per day (i.e., rate of seed growth) and the duration of this phase (i.e., number of days for seed filling). During the seed filling period, the seed growth rate and the duration are sensitive to growing conditions. Thus, any limitation on resources availability (e.g., water, radiation, and nutrients) during this period can be translated into reductions in seed weight that ultimately will affect final seed yield. The objective of this study was to identify late-season management practices potentially contributing to increased final seed weight and seed yield in soybeans.

Procedures

A field study was conducted at the Ashland Bottoms Research Farm, Ashland Bottoms, KS (39.14° North, 96.64° West). The type of soil was quartic Argiduoolls (18% clay, 54% silt, and 28% sand). Soil samples were collected before planting at 6-inch soil depth. The pH was 7.6, soil phosphorus (Mehlich) was above the critical threshold (90 ppm), and soil organic matter was 2.1%. The soybean variety utilized for this study was P38T20X (a maturity group 3.8; DuPont Pioneer), planted June 26, 2019, under rainfed conditions and a target plant density of 145,650 plants per acre. Maximum average temperature during the season was 83.1°F and 62.0°F the minimum. Total seasonal precipitation was 15.95 inches from planting to harvest.

Plots were arranged in a complete randomized block design with four replications. Plots were 45 feet long with four rows spaced at 30 inches. Treatments were applied at full pod formation (R4 growth stage) and consisted of different management practices:

- Fungicide protection late-season application
- Insecticide protection late-season application
- Full-foliar protection (fungicides + insecticides late-season application)
- Nitrogen fixation longevity (inoculant late-season application)
- Plant nutrition -standard- (S late-season application)
- Plant nutrition -complete- (use of micronutrients plus S late-season application)
- Nutrition -complete- + N fixation (combination of both to improve nutrition)

- Intensified inputs (all practices combined)
- Control condition (standard practices)

When needed, plots were sprayed to control weeds, pests, and diseases with a handheld backpack sprayer.

In each soybean plant within all treatments, seed samples were collected 15 days after the onset of seed filling and every 7 or 10 days until physiological maturity (R7 growth stage). Final seed weight, rate, and duration were determined fitting a bi-linear model to the data collected.

$$\text{Seed weight (mg/seed)} = a + b \times d \text{ (for } d < c) \quad [1]$$

$$\text{Seed weight (mg/seed)} = a + b \times c \text{ (for } d > c) \quad [2]$$

where b is the linear seed growth rate (mg/day), and c is the duration of the seed filling period in days.

At physiological maturity, an area of 18.75 ft² in the two central rows of each plot was manually harvested to determine final seed yield.

Results

Seed Yield and Seed Weight

Seed yield ranged between 34.2 and 52.3 bu/a and seed weight ranged from 132 to 166 mg/seed, respectively. However, statistical differences among treatments were not detected for yield or seed weight (Figures 1, 2, 3, and 4).

Duration and Rate

Rate and duration of seed filling were not affected by any of the evaluated treatments (Figures 2 and 3). Thus, variation observed in all the investigated variables can be mainly attributed to the spatial variability of the experimental conditions.

Conclusions

Treatments applied did not affect final seed weight or seed yield. Furthermore, across all treatments similar trends were observed for the seed growth rate and seed filling duration. Future research should consider evaluating the effect of these treatments tested at different crop growth stages.

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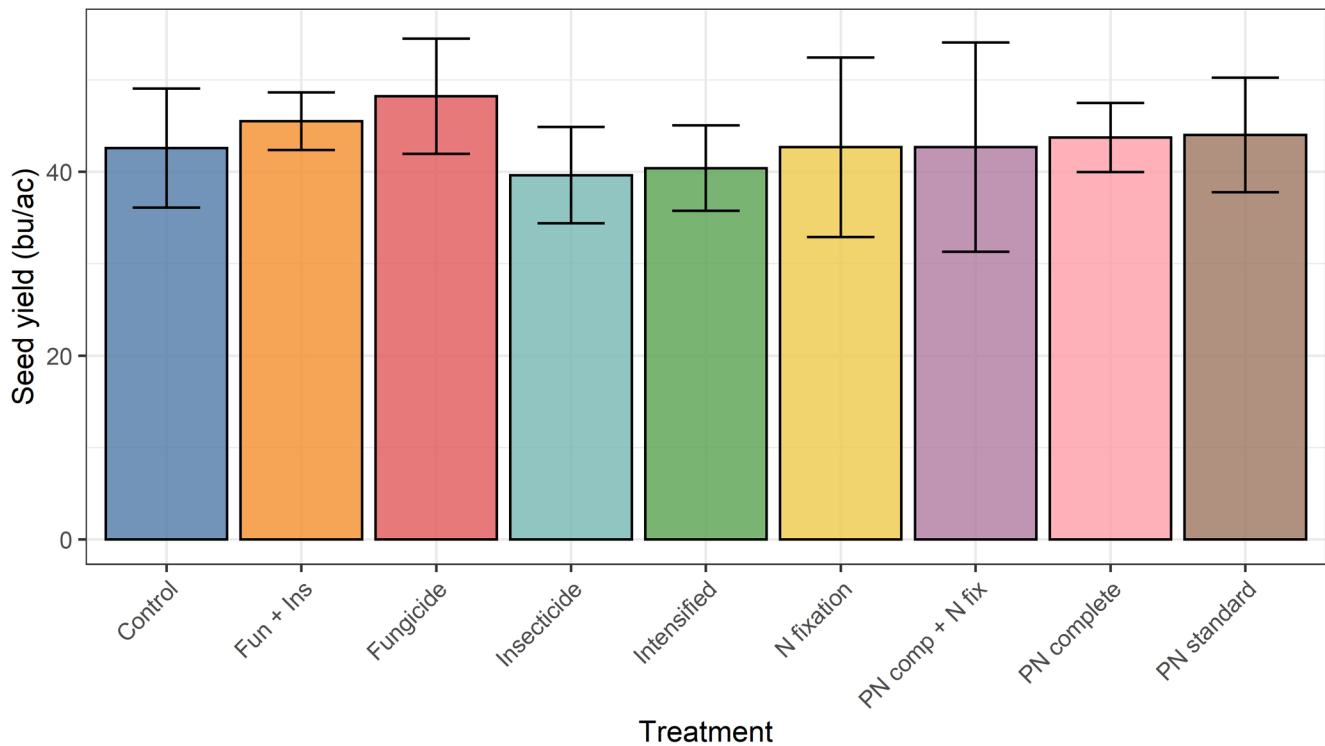


Figure 1. Seed yield (bu/a) for each treatment. The top vertical bars are the 95% confidence interval. Fun + Ins = fungicide and insecticide. N = nitrogen. PN = plant nutrition.

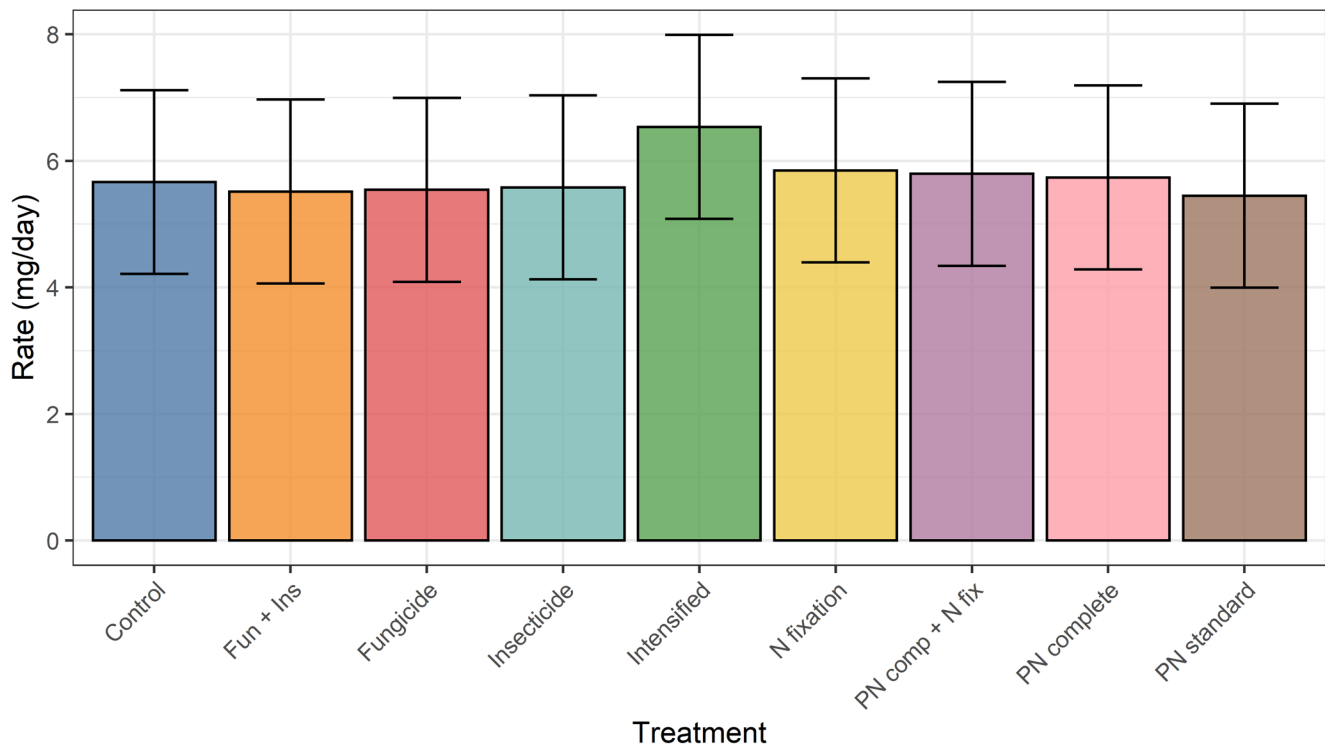


Figure 2. Seed filling rate for each treatment. The top vertical bars are the 95% confidence interval. Fun + Ins = fungicide and insecticide. N = nitrogen. PN = plant nutrition.

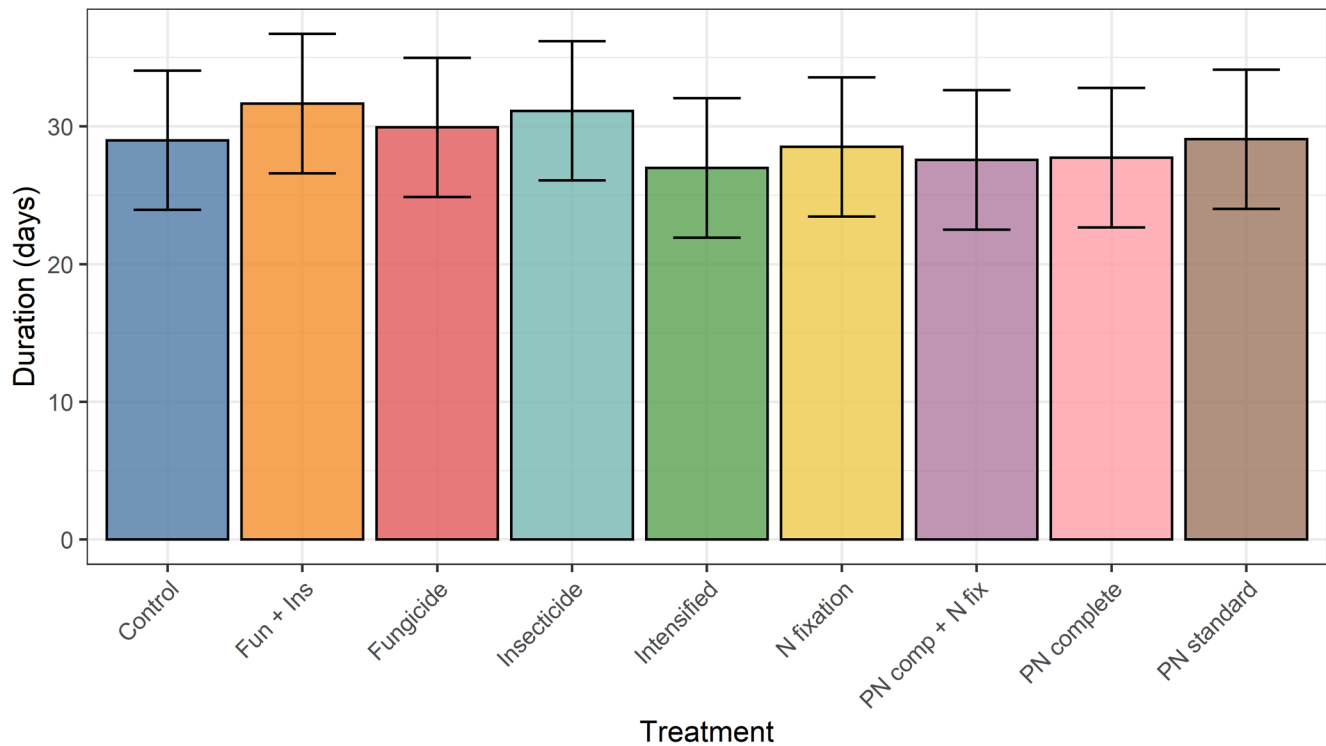


Figure 3. Seed filling duration for each treatment. The top vertical bars are the 95% confidence interval. Fun + Ins = fungicide and insecticide. N = nitrogen. PN = plant nutrition.

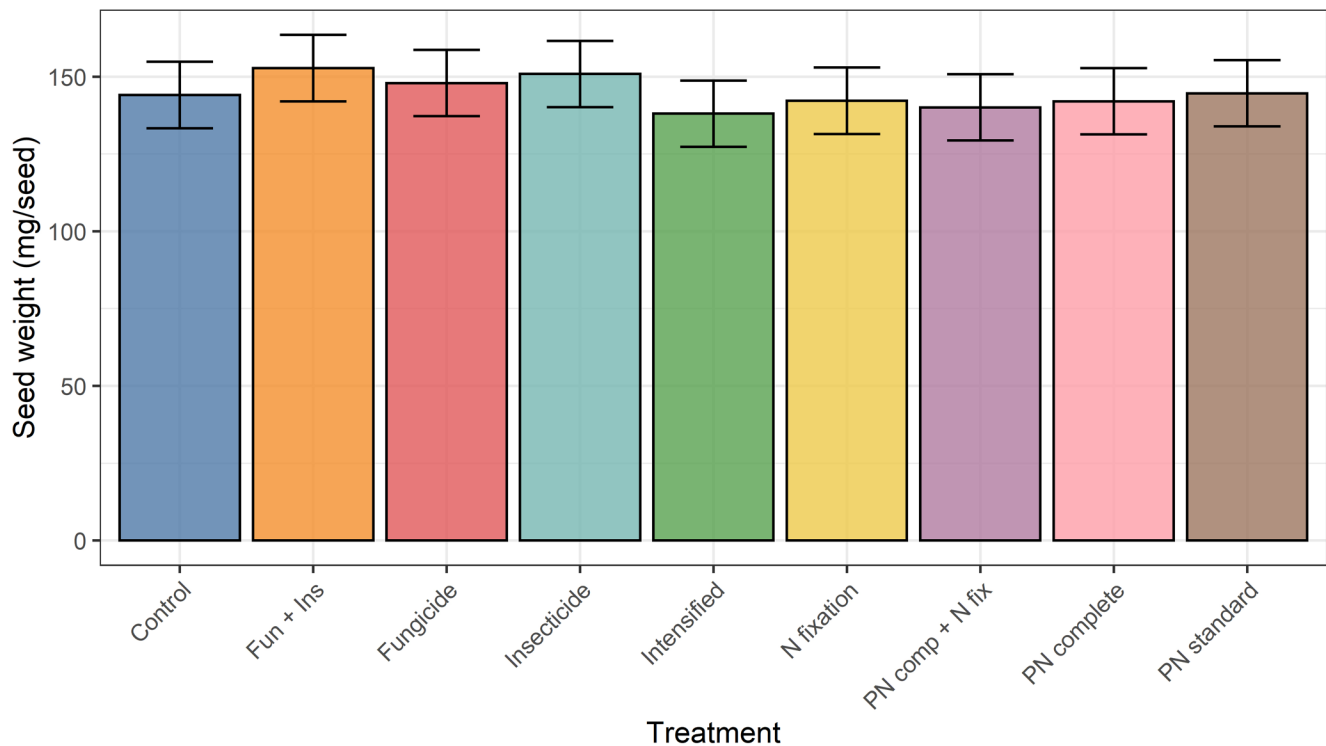


Figure 4. Final seed weight rate for each treatment. The top vertical bars are the 95% confidence interval. Fun + Ins = fungicide and insecticide. N = nitrogen. PN = plant nutrition.

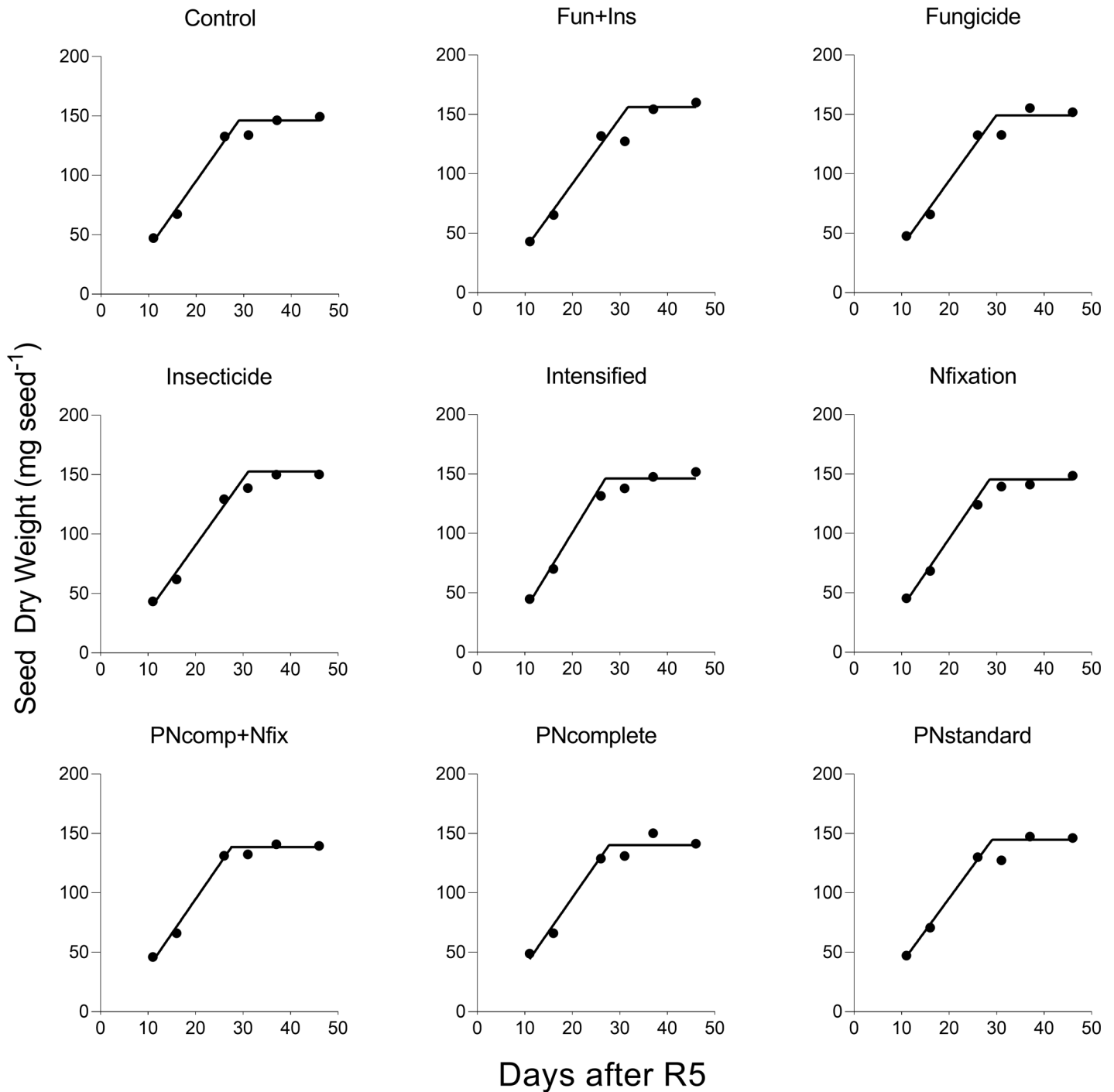


Figure 5. Changes in seed dry weight accumulation from the onset of the seed filling (R5 growth stage) until physiological maturity, end of the season. Each point represents the average of four replications. Fun + Ins = fungicide and insecticide. N = nitrogen. PN = plant nutrition.