

## Effects of Reduced Solar Radiation on Corn Growth and Yield

### Key Findings:

- Reduced solar radiation had a large impact on corn yield and stalk quality. Specific effects differed depending on when the reduction occurred.
- Corn was most susceptible to yield loss when reduced solar radiation occurred during pollination
- Reduced solar radiation during grain fill resulted in lower kernel weight and stalk strength.

### Rationale and Objective

- Along with water and nutrients, solar radiation (sunlight) is an essential input for crop growth and yield.
- Photosynthetically active radiation can be reduced by over 60% on cloudy and rainy days compared to full sunlight.
- Extended periods of low solar radiation during grain fill can reduce yield and cause stalk quality issues as corn plants remobilize stalk carbohydrates to the ear.
- A field demonstration was conducted during 2021 to show how a reduction in solar radiation at various stages of corn growth impacts corn ear development and final yield.

### Study Description

- The field demonstration was conducted near Montgomery, Indiana.
- Two-row plots of four different Pioneer® brand corn products ranging from 109 to 113 CRM were planted on April 24.
- A shade structure that reduced solar radiation by approximately 70% was installed over a portion of the plot area beginning at the V13 growth stage (Figure 1).
- The shade structure was rolled down the row to shade a different portion of the plot area after the accumulation of approximately 320 GDUs.
- A total of five different shade timings were applied as part of the demonstration (Table 1).
- Kernels per row, kernel weight, corn yield, and stalk strength were measured for each hybrid and shade treatment.
- Stalk strength was assessed using a standard push test in which plants were pushed 30 degrees from vertical and either snapped back to vertical or crimped and fell over.



**Figure 1.** Shade structure that was used to apply reduced solar radiation treatments.

**Table 1.** Shade treatment timings.

Treatment	Date Initiated	Date Ended	GDUs*
V13-VT	June 17	July 3	407
VT-R2	July 3	July 15	313
R2-R3	July 15	July 29†	313
R4	July 30	Aug 14	363
R5	Aug 14	Aug 28	325

\* Source: <https://mrcc.purdue.edu/U2U/gdd/>

† Canopy was temporarily removed July 22 and 23.

### Results

- The number of kernels per row was reduced when plants were shaded prior to R3 (Figure 2).
- A 70% reduction in solar radiation during pollination resulted in near-total pollination failure.
- Shade during R2 and early R3 caused kernels that had successfully pollinated at the tip of the ear to abort.
- Shade during R4 and R5 did not reduce the number of kernels per row but did reduce kernel weight (Figure 3).
- Maximum kernels weights occurred when pre-pollination shading reduced the total number of kernels, but solar radiation was not reduced at any point during grain fill.
- Reducing solar radiation during R4 and R5 reduced available photosynthate for grain fill resulting in reduced kernel weights, stalk cannibalization, and weaker stalks (Figure 5).

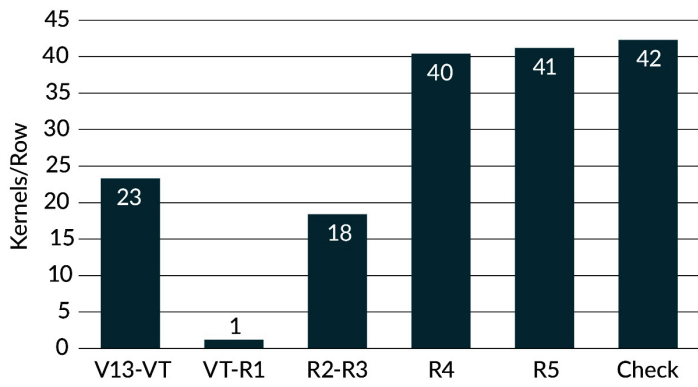


Figure 2. Shade treatment effects on kernels per row.

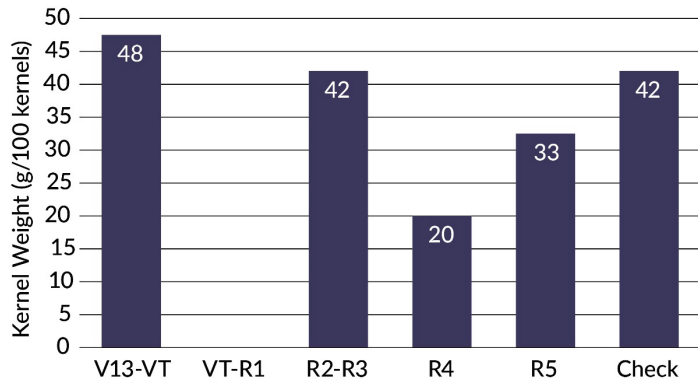


Figure 3. Shade treatment effects on kernel weight.

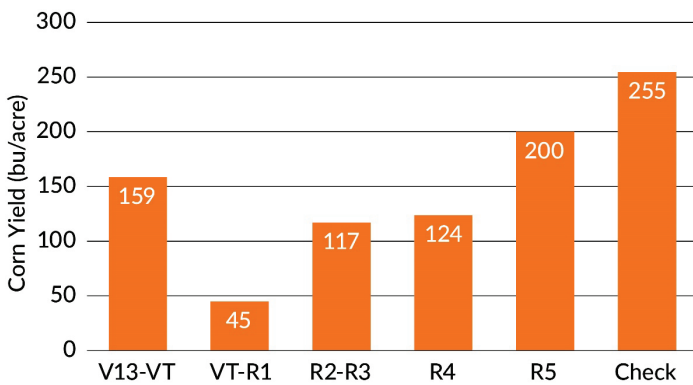


Figure 4. Shade treatment effects on corn yield.

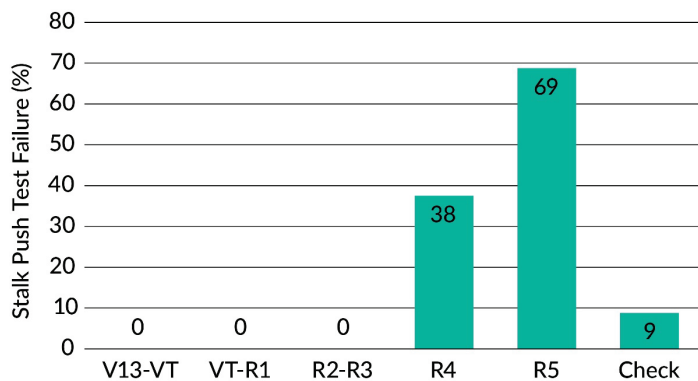


Figure 5. Shade treatment effects on stalk strength.



Figure 6. Shade treatment effects on pollination and ear length.

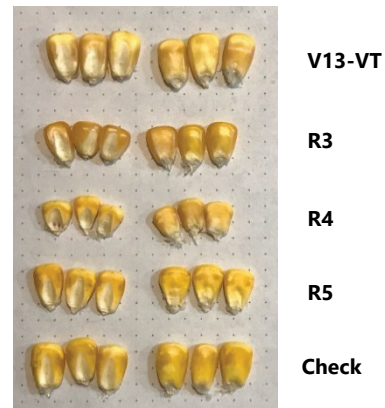


Figure 7. Shade treatment effects on kernel size.

### Corn Growth Stage

### Effect of 70% Reduced Solar Radiation on Growth and Yield

#### V13-VT

- Additional set of brace roots
- Reduced internode length
- Smaller leaves at final nodes
- Decreased tassel size
- Reduced kernels per row
- **Yield loss = 38%**

#### VT-R1

- Delayed ear development and silk emergence
- Near-total pollination failure
- **Yield loss = 82%**

#### R2-R3

- Increased kernel abortion at ear tips
- Kernels per row reduced by over 50%
- **Yield loss = 54%**

#### R4

- Kernel weight reduced by over 50%
- Reduction in stalk strength
- **Yield loss = 51%**

#### R5

- Reduced kernel weight
- Dramatic reduction in stalk strength
- **Yield loss = 21%**

Special thanks to Michael Wagler and the Rosedale Ag Service team for their work on this trial.