Improving management of white mold in dry beans: Optimizing **fungicide timing** in black beans

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Optimizing fungicide application timing

Research question tested in these studies:
when should fungicides be applied
when soil moisture and canopy wetness are high-risk
for white mold as dry beans enter bloom?

If conditions do not favor white mold as dry beans enter bloom, applications should be delayed until weather becomes favorable for white mold.

Improving white mold management in dry beans:
Fungicide application timing – methods

Row spacing = 14 inches in most studies; 28 inches in some studies

Seeding rate = 100,000 or 110,000 viable seeds/ac

Fungicide spray volume = 15 gal/ac.

Fungicides applied with a hand-held boom pressurized by CO_2.

Fungicide spray droplet size: fine in study conducted in Oakes in 2017; medium in study conducted in Carrington in 2017; fine, medium or coarse, calibrated relative to canopy density and lodging, in 2020-2022.

Interval between sequential applications: 10 to 14 days, depending on study

Number of experimental replicates = 6, 12, 15 or 16, depending on study

White mold assessment: Assessed at or near dry bean maturity by evaluating every plant individually in minimum half of the rows per plot for percent of the plant impacted by white mold.

Harvest: To ensure that variability in dry bean standability (lodging) across the study did not bias yields, plants were clipped at base concurrent with disease assessments, wind-rowed to dry, and manually lifted into the combine.

Supplemental irrigation: Supplemental overhead irrigation was applied as needed to establish the white mold disease pressure needed to evaluate fungicide performance.

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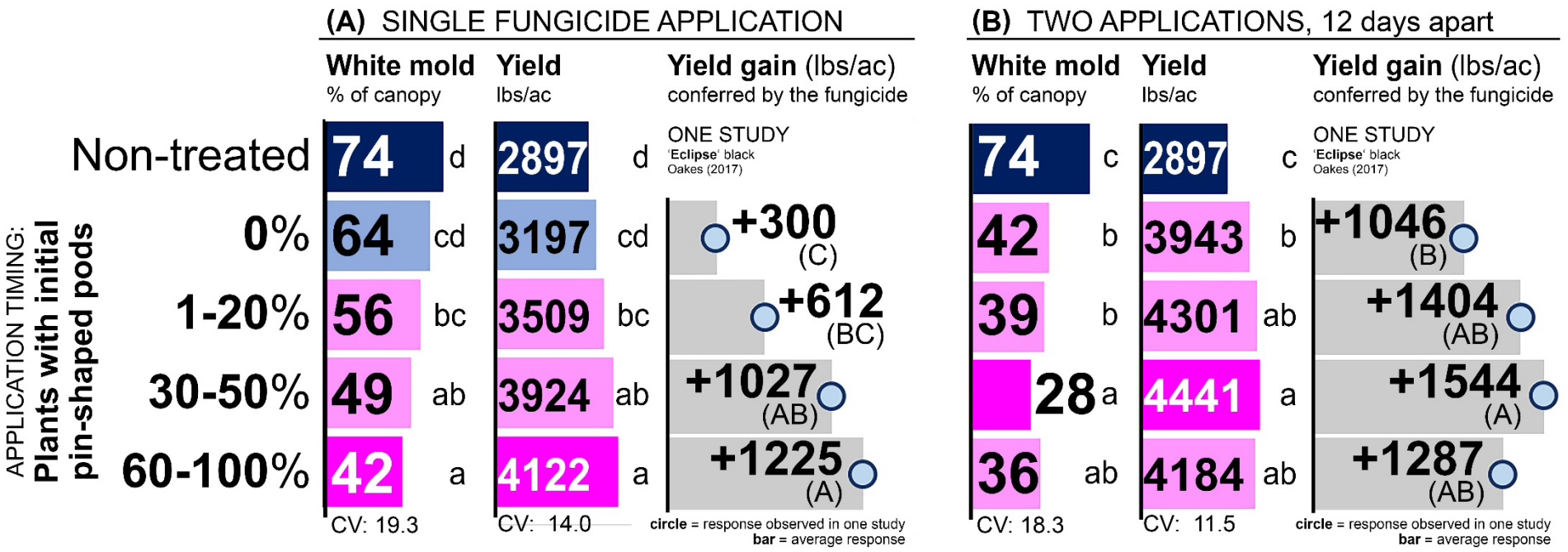
Optimizing fungicide application timing: **black beans**

BLACK BEANS – study where a single application had efficacy.
Closed canopy, cool temperatures at initial pod.

BLACK
canopy at or near closure

average **88% canopy closure when 1-20% of plants had initial pods**
average **97% canopy closure when 60-100% of plants had initial pods**
average daily high observed between 2nd and 3rd application timing: **79°F**
average daily high observed between 3rd and 4th application timing: **82.5°F**



'Eclipse' black beans Oakes, ND (2017)

Within-column means followed by different letters are significantly different (*P* < 0.05; Tukey procedure)
Topsin (30 fl oz) or Topsin (30 fl oz) followed by Endura (8 oz) 12 days later
Row spacing = 14". Spray volume = 15 gal/ac.

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

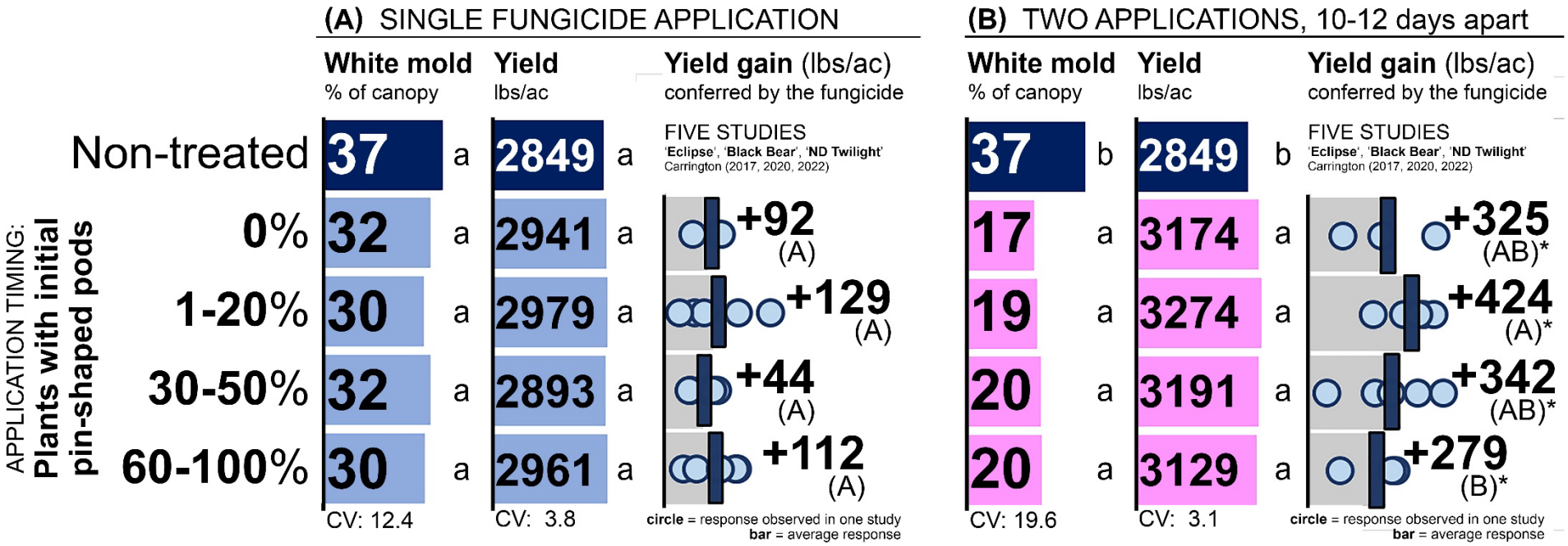
Optimizing fungicide application timing: **black beans**

BLACK BEANS – studies where a single application had no efficacy. Open canopy, cool temperatures at initial pod.

BLACK
open canopy

average **60-86% canopy closure when 1-20% of plants had initial pods**
average **70-90% canopy closure when 60-100% of plants had initial pods**

average daily high observed between 2nd and 3rd application timing: **79-80°F**
average daily high observed between 3rd and 4th application timing: **80-81.5°F** (3 studies), **90°F** (2 studies)



'Black Bear', 'Eclipse' and 'ND Twilight' black beans Carrington, ND (2017, 2020, 2022)
Within-column means followed by different letters are significantly different (*P* < 0.05; Tukey procedure)
Topsin (30 or 40 fl oz) or Topsin (30 or 40 fl oz) followed by Endura (8 oz) 10-12 days later
Row spacing = 14" or 28". Spray volume = 15 gal/ac.

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Optimizing fungicide application timing: **black beans**

(1) Single fungicide application – black beans

A single fungicide application only provided satisfactory management of white mold in 1 of 6 studies.

- Optimal application timing in this study was 90-100% of plants with initial pods

(2) Two fungicide application sequence – black beans

Fungicide efficacy was optimized when the first application was made when **1-30% of plants had initial pods.**

- When conditions are highly favorable for white mold, applications should be targeted for 1-20% of plants with initial pods
- When conditions are less favorable for white mold, applications should be targeted at 20-30% of plants with initial pods

The canopy was open in all of the studies in which application timing was tested (<95% closure through 50% of plants with initial pods).

Fungicide application timing – fundamental concepts

Penalty to applying too late:

Fungicide applications must be made prior to pathogen infection.

- You cannot eradicate existing disease.
- Some, but not all, modern fungicides exhibit some degree of curative activity, but this curative activity is limited to the first few hours after pathogen infection – when pathogen infection can be seen only with a microscope and before disease lesions are present.

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Fungicide application timing – fundamental concepts

Penalty to applying too early:
New growth is not protected by the fungicide.

- Only the biomass that exists at the time that the fungicide is applied is protected.
- This is a problem for white mold management because dry beans exhibit significant growth during early bloom.
- Dry beans increase in susceptibility to white mold as the percent of plants with initial pods (= % of plants with dead blossoms) increases

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Improving crop disease management:

Fungicide application timing – fundamental concepts

New growth is not protected by the fungicide.

- Example from field peas
- These peas were treated with a fungicide at bloom initiation
- Growth that occurred after bloom initiation was unprotected and became diseased with powdery mildew.
  - ➢ This is why (in the picture at the right) the upper ~ 1/5 of the canopy is diseased and the lower ~ 4/5 of the canopy is healthy.

Optimizing fungicide application timing

CHALLENGES:

- White mold management not very good even at optimal application timing.
  - Disease rarely reduced by even 50%
- Applying at the perfect timing is very difficult
  - Dry bean growth & development is variable within most fields
  - Not every day is a suitable day for spraying

Optimizing fungicide application timing

Can we improve fungicide performance by modifying application interval and/or application frequency?

- Reducing the application interval reduces the amount of unprotected new dry bean growth and should reduce the penalty to applying fungicides applying too early
- … but may require a third fungicide application under high disease pressure




People

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