# Improving management of white mold in **pinto beans**: Optimizing **fungicide spray volume**

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# Optimizing fungicide spray volume

Research question tested in these studies:
**what is the impact of fungicide spray volume** on white mold management in pinto beans?

# Improving white mold management in dry beans:
## Fungicide spray volume – methods

**Study location:** Carrington

**Row spacing** = 14 inches

**Seeding rate** = 90,000 viable seeds/ac

**Driving speed, nozzles, and application pressure within each study were kept constant across spray volumes by modifying pulse width**.

**Fungicide spray droplet size:** calibrated relative to canopy density and lodging from 2022-2024; medium droplets in both applications in 2020-2021.

**Number of experimental replicates** = 7 to 14, depending on the study year

**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.

# Improving white mold management in dry beans:
## Fungicide spray volume – methods

**Table 1. Detailed methods – fungicide spray volume studies, pinto beans**

| Location and year | | Carrington 2020 | Carrington 2021 | Carrington 2022 | Carrington 2023 | Carrington 2024 |
|---|---|---|---|---|---|---|
| App. #1 | Driving speed | 6.0 mph | 6.0 mph | 9.0 or 11.5 mph | 6.0 mph | 6.0 mph |
| | Fungicide | Endura 8 oz/ac | Topsin 40 fl oz | Topsin 40 fl oz | Topsin 40 fl oz | Topsin 40 fl oz |
| | Droplet size | Medium | Medium | Medium | Medium | Medium |
| | Nozzles, psi | XR11006, 35 psi | XR11006, 35 psi | XR11008, 50 psi | XR11006, 35 psi | XR11006, 35 psi |
| App. #2 | Driving speed | 6.0 mph | 6.0 mph | 8.0 mph | 7.0 mph | 6.0 mph |
| | Fungicide | Endura 8 oz/ac | Endura 8 oz/ac | Endura 8 oz/ac | Endura 8 oz/ac | Endura 8 oz/ac |
| | Droplet size | Medium | Medium | Coarse | Coarse | Coarse |
| | Nozzles, psi | XR11006, 35 psi | XR11006, 35 psi | XR11010, 30 psi | XR11008, 30 psi | XR11010, 30 psi |
| Applic. interval | | 11 days | 12 days | 11 days | 10 days | 7 days |
| Plot size (average) | | 5 x 10.9 ft | 5 x 16.8 ft | 5 x 17.8 ft | 5 x 15.2 ft | 5 x 16.5 ft |
| Exp. replicates | | 14 | 8 | 8 | 10 | 7 |

**Plot size =** Harvested plot size. The planted plot size and sprayed area were larger.

Non-harvested plots were established on either side and either end of sprayed plots to permit overspray of treatments and facilitate turning on and off the spray boom between treatment plots while maintaining full driving speed.

# Calibration

**Pulse width was modified as needed to maintain the same driving speed, nozzles and application pressures across spray volume treatments.**

**Pulse-width calibration was manually conducted in the field** (with the fungicide in the tank) **immediately before application.**

**Objectives:**

1. **Ensure the precise target spray volume.** Manual adjustments to pulse width were made as needed.
2. **Confirm that all nozzles are operating correctly** – consistent output across all nozzles; no plugs.

# Calibration

A pulse width modulation system from Capstan AG that permits manual pulse width calibration was utilized.

- Immediately before applying treatments (after the fungicide was added to the tank), the sprayer was run for 10.0 seconds. Spray output was measured for each nozzle.
- Pulse width was manually adjusted until the correct output was achieved for the driving speed and spray volume

# Application methods

**Applications were made with a tractor-mounted, PTO-driven spray equipped with a pulse width modulation system**

# Fungicide spray volume: pinto beans

| **Growth stage** | Study location: Carrington, ND | | | | | | Dry bean market class: pinto | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| at time of application | 2020 | | 2021 | | 2022 | | 2023 | | 2023 | | 2024 | |
| *pinto bean variety* | Palomino | | Palomino | | Palomino | | Torreon | | Vibrant | | Torreon | |
| | applic. #1 | | applic. #1 | | applic. #1 | | applic. #1 | | applic. #1 | | applic. #1 | |
| % plants in bloom: | 54 | | 75 | | no data | | 100 | | 100 | | 88 | |
| % plants with pods: | 6 | | 30 | | no data | | 38 | | 36 | | 26 | |
| max pod length (in.) | no data | | 1.0 | | no data | | 1.2 | | 1.1 | | 0.5 | |
| *application number* | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 |
| canopy closure (%) | 69.5 | 87.1 | 52.1 | 95.0 | 60.6 | 89.8 | 94.0 | 98.5 | 94.2 | 93.9 | 80.4 | 88.0 |
| canopy height (in.) | 15.4 | 18.9 | 18.3 | 18.0 | no data | 19.8 | 20.2 | 27.5 | 20.5 | 26.5 | 19.8 | 22.0 |
| trifoliates/plant | no data | | no data | | no data | | 13.3 | 29.8 | 13.3 | 33.6 | no data | no data |
| lodging (% from vertical) | no data | | no data | | no data | | no data | 9.3 | no data | 7.0 | 22.0 | 42.7 |

| **Delta T** | Study location: Carrington, ND | | | | | | Dry bean market class: pinto | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| at time of application | 2020 | | 2021 | | 2022 | | 2023 | | 2023 | | 2024 | |
| *pinto bean variety* | Palomino | | Palomino | | Palomino | | Torreon | | Vibrant | | Torreon | |
| *application number* | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 | app 1 | app 2 |
| Non-treated | | | | | | | | | | | | |
| **10 gal/ac** | 7.6 | 3.7 | 5.7 | 4.3 | 9.2 | 1.8 | 6.5 | 3.9 | 6.5 | 3.9 | 3.9 | 4.6 |
| **15 gal/ac** | 6.8 | 3.4 | 5.1 | 3.1 | 9.3 | 1.7 | 6.5 | 3.8 | 6.5 | 3.8 | 3.9 | 4.6 |
| **20 gal/ac** | 7.3 | 3.8 | 5.3 | 4.0 | 9.2 | 1.4 | 6.4 | 3.6 | 6.4 | 3.6 | 4.0 | 4.6 |
| **25 gal/ac** | 7.3 | 4.0 | 6.0 | 4.8 | 9.2 | 1.2 | 6.3 | 3.6 | 6.3 | 3.6 | 4.1 | 4.6 |

**2020, 2021, 2023, 2024: All treatments were applied under optimal Delta T (optimal evaporative potential)**

**2022: Treatments were applied under marginal Delta T**

Application #1, 2022: High Delta T (high evaporative potential) Application #2, 2022: Low Delta T (low evaporative potential)

# Fungicide spray volume: **pinto beans**

The response to spray volume was inconsistent across studies.

**A trend of increased yield and reduced white mold with increased spray volume was observed in only 2 of 6 studies.** The trend was not statistically significant.

| **WHITE MOLD** % of canopy | Study location: Carrington, ND | | | Dry bean market class: pinto | | | **Combined analysis** |
|---|---|---|---|---|---|---|---|
| | 2020 | 2021 | 2022 | 2023 | 2023 | 2024 | |
| *pinto bean variety* | Palomino | Palomino | Palomino | Torreon | Vibrant | Torreon | White mold (%) |
| Non-treated | **56** b | **58** b | **60** b | **73** b | **61** b | **50** c | **60** b |
| **10 gal/ac** | **44** a | **46** a | **42** a | **52** a | **48** ab | **23** ab | **42** a |
| **15 gal/ac** | **43** a | **37** a | **45** a | **54** a | **47** ab | **23** ab | **41** a |
| **20 gal/ac** | **45** a | **42** a | **40** a | **60** ab | **43** a | **32** b | **44** a |
| **25 gal/ac** | **43** a | **48** ab | **40** a | **50** a | **37** a | **18** a | **39** a |
| CV: | 21.7 | 17.7 | 20.2 | 22.8 | 29.3 | 17.3 | 9.3 |

| **PINTO BEAN YIELD** (lbs/ac) | Study location: Carrington, ND | | | | | | **Combined analysis** |
|---|---|---|---|---|---|---|---|
| | 2020 | 2021 | 2022 | 2023 | 2023 | 2024 | |
| *pinto bean variety* | Palomino | Palomino | Palomino | Torreon | Vibrant | Torreon | Yield (lbs/ac) |
| Non-treated | **2680** b | **2126** b | **2822** b | **1854** b | **2385** b | **3122** b | **2498** b |
| **10 gal/ac** | **3364** a | **2680** a | **3339** a | **2961** a | **3056** a | **3967** a | **3228** a |
| **15 gal/ac** | **3116** ab | **2786** a | **3373** a | **2932** a | **3113** a | **3859** a | **3197** a |
| **20 gal/ac** | **2961** ab | **2892** a | **3548** a | **2591** a | **3275** a | **3842** a | **3185** a |
| **25 gal/ac** | **3233** a | **2665** a | **3479** a | **2922** a | **3399** a | **4012** a | **3285** a |
| CV: | 11.3 | 9.3 | 7.0 | 20.0 | 15.3 | 8.4 | 4.8 |

Within-column means followed by different letters are significantly different ($P < 0.05$; Tukey multiple comparison procedure)

# Fungicide spray volume: **pinto beans**

RESPONSE TO FUNGICIDE SPRAY VOLUME:

**Combined analysis across six studies** conducted over 5 years

Carrington, ND (2020-2024)

**Endura** 8 oz/ac applied twice (1 study)

**Topsin** 40 fl oz f.b. **Endura** 8 oz (5 studies)

| Fungicide spray volume | **White mold** % of canopy | **Yield** lbs/ac | **Yield gain** (lbs/ac) **from fungicide** |
|---|---|---|---|
| Non-treated | 60 b | 2498 b | |
| **10 gal/ac** | 42 a | 3228 a | 730 a |
| **15 gal/ac** | 41 a | 3197 a | 698 a |
| **20 gal/ac** | 44 a | 3185 a | 687 a |
| **25 gal/ac** | 39 a | 3285 a | 787 a |
| CV: | 9.3 | 4.8 | 19.4 |



Within-column means followed by different letters are significantly different ($P < 0.05$; Tukey multiple comparison procedure)

# Fungicide spray volume: **pinto beans**

**On average across six studies, little or no response to spray volume was observed.** These results parallel findings from fungicide spray volume testing conducted targeting white mold in soybeans.

**Most of the testing was conducted under optimal spray conditions. A stronger response to spray volume might be observed under sub-optimal spray conditions.**

- Spray volume testing under sub-optimal spray conditions in one study (2022; application #1 applied when evaporative potential was high, application #2 applied when evaporative potential was low).
- High evaporative potential = low relative humidity, especially when combined with warm temperatures
- Low evaporative potential = increased risk of drift and, when leaves are wet with dew, risk of runoff and irregular fungicide deposition
- Response to spray volume is expected to be highest under conditions of high evaporative potential

# People

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