

# Influence of Seed Moisture Content and Fan Speed on Air Seeder Damage of Dry Beans

## Acknowledgements

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## Project Overview

In air-seeding operations, dry bean seed is susceptible to mechanical damage, which can markedly decrease germination rates and seedling vigor, ultimately compromising crop yield and quality. Two operator-adjustable parameters – seed travel speed, as governed by the air-seeder’s fan settings, and seed moisture content – may influence the extent of this damage.

This summary outlines the results of project R23033P conducted by PAMI to examine how fan speed and seed moisture content affect dry bean seed damage during air seeding. Windbreaker pinto beans and Blackstrap black beans were evaluated under nine trial conditions each, based on combinations of three fan speeds (low, medium, high) and three seed moisture contents (11%, 12.5%, 14%).

## Important Findings

Damage to both pinto and black bean seeds occurred in the air seeder across all operating conditions, leading to significant reductions in seed germination, vigor, and seed coat smoothness.

A strong interaction effect was observed between seed moisture content and fan speed. Lower seed moisture contents and higher fan speeds resulted in greater seed damage and lower germination, vigor, and smoothness values, indicating that both seed moisture and fan speed must be controlled for optimal outcomes.

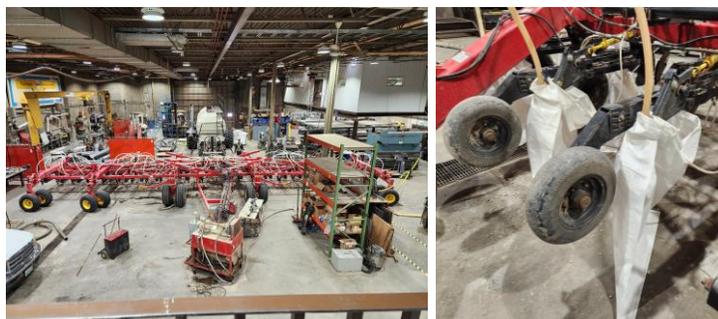
The highest germination and vigor rates, ranging from 65% to 70%, were observed at a moisture content of 14% and the lowest possible fan speed; however, these results are still considered suboptimal.

A 20% increase in fan speed over the recommended minimum caused germination and vigor to fall to less than 30% in all moisture levels. Similarly, using seed with low moisture content (11%) caused germination and vigor to fall to less than 35%, even at the lowest fan speed.

Seed coat smoothness also declined significantly with decreasing moisture and increasing fan speed, particularly in black beans, with values dropping to as low as 10% in some trials.

## Testing Parameters and Equipment

Tests were performed indoors using a Bourgault 3320 Paralink Hoe Drill (18.3 m width) with a 6550ST air cart. Seed was conditioned using aeration methods to target the required moisture levels. Three fan speeds were used for testing: a low speed set to the minimum at which the distribution tubes remained clear (no plugging); a medium speed that corresponded to the air seeder manufacturer’s recommended minimum for the target seeding rate; and a high fan speed that was 20% above the manufacturer’s recommended minimum. Seed samples were collected and analyzed for germination, vigor, and seed coat smoothness.



Bourgault PHD 3320-10 toolbar with 6550ST air cart assembled in PAMI shop for testing. Poly woven bags clamped to seed openers for seed capture.

# Results

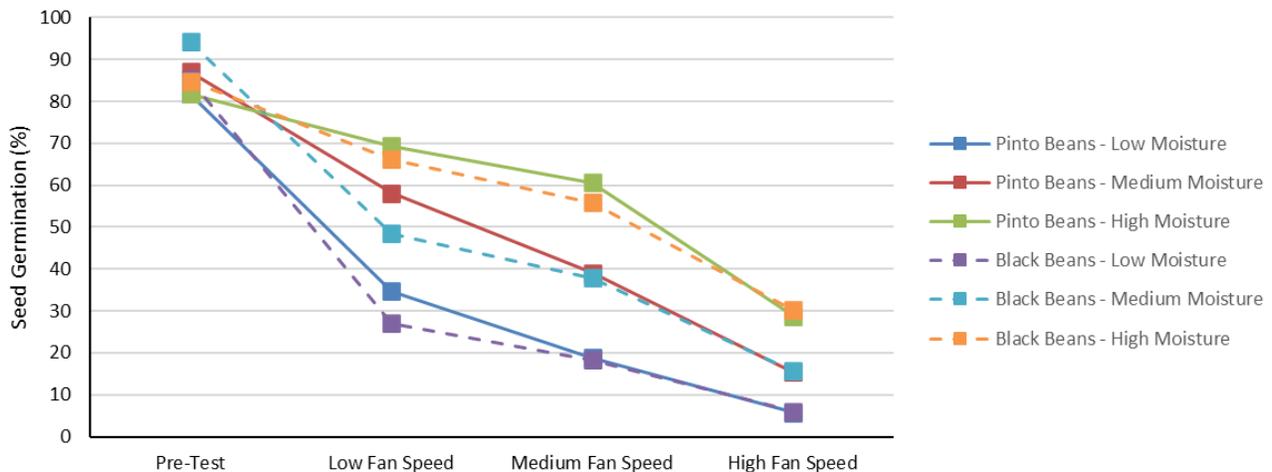
Key findings across both bean varieties are as follows:

- Higher seed moisture and lower fan speeds reduced mechanical damage.
- Pinto beans: Best outcomes (~70% germination) at high moisture and low fan speed; worst (<10% germination) at low moisture and high fan speed.
- Black beans: Similar trends but less pronounced; best outcomes (~60% germination) at high moisture and low to medium fan speed; worst (<10% germination) at low moisture and high fan speed.
- Even under optimal conditions, some degree of damage persisted, suggesting that operational compromises are necessary.

## Germination Results

Pinto Beans	Moisture Level	Low Fan Speed	Medium Fan Speed	High Fan Speed
	Low (11%)	34.7%	18.9%	5.8%
	Medium (12.5%)	58.1%	39.0%	15.4%
	High (14%)	69.3%	60.6%	28.8%

Black Beans	Moisture Level	Low Fan Speed	Medium Fan Speed	High Fan Speed
	Low (11%)	27.0%	18.3%	6.1%
	Medium (12.5%)	48.5%	37.9%	15.6%
	High (14%)	66.2%	55.9%	30.2%



Decreasing trends in percentage seed germination of low, medium, and high moisture pinto beans (solid lines) and black beans (dashed lines) at low, medium, and high fan speeds.

## Recommendations for Producers

To reduce mechanical damage when using air seeders for dry beans, seed moisture should be maintained at or above 14%.

Air seeders should be operated at the lowest fan speed possible that still prevents plugging, even if this means going below the manufacturer's recommended minimums.

Given the expected reduction in germination and vigor, seeding rates should be adjusted upward to ensure adequate plant stands.

It is also important to evaluate the feasibility of using low fan speeds in field conditions, as plugging may limit their use despite the benefits observed in controlled environments.

Regular calibration and maintenance of air seeder components should be prioritized to maintain consistent seed distribution, particularly when operating at reduced airflows.

Where possible, post-seeding testing of seed vigor and germination is recommended to assess the effectiveness of the seeding system.