Canadian Agronomist

DIGGING INTO RESEARCH

# Foliar-applied hail recovery treatments ineffective

CATEGORY **agronomy** | *July 25, 2022*

Simulated hail damage led to reductions in height, biomass, NDVI, grain yield, and kernel weight in wheat, field pea and dry bean. Average yield losses from heavy hail damage were up to 35% in wheat and dry bean, and 45% in field pea. Hail damage during the early growth stage resulted in lower yield loss compared to hail damage at the mid-growth and late growth stages. Application of foliar fungicides or nutrient blends as recovery products did not improve crop recovery, grain yield, or kernel weight for any of the crops.

Hail can be devastating to crops, depending on the crop stage and severity of the hail. Research was conducted to assess the effect of timing and severity on crop growth, grain yield and kernel weight in wheat, field pea and dry bean. Another objective was to evaluate foliar fungicides and nutrient blends for their effects on plant growth, grain yield and kernel weight.

Wheat and field pea experiments were conducted at Lethbridge, Vegreville, and Falher, Alberta, under dryland conditions in 2016, 2017 and 2018. Dry bean experiments were conducted at Lethbridge location under dryland conditions in 2016, 2017, and 2018. This resulted in 9 site-years of data for wheat and pea, and 3 site-years for dry bean.

Hail damage was simulated by attaching a series of short chains to a rotating drum mounted on a front-end loader, and driving it over the plots at a controlled height and speed. Light hail severity resulted in an average of 42.3% hail damage, and heavy hail resulted in 66.8% hail damage. These severity levels were calibrated with the assistance from crop adjusters with Alberta's Agriculture Financial Services Corporation.

Timing of simulated hail application targeted different crop growth stages:

(1) early growth stage targeting the tillering stage for wheat (BBCH 30) and 4–6 leaf stage for the pulse crops (BBCH 14–16),

(2) mid-growth stage that targeted flag leaf emergence for wheat (BBCH 39) and early flowering for pulses (BBCH 60), and

(3) late growth stage that targeted flowering for wheat (BBCH 60) and early pod stage for pulses (BBCH 71).

Recovery products were applied 1 to 3 days after hail damage. For field pea, a foliar application of ReLeaf Canola (5–20–5–0.5B–0.2Mn) at the 2 L/ac (4.9 L/ha) rate plus Boron Boost F at the 0.33 L/ac (0.82 L/ha) rate were applied as a nutrient recover product. Headline (pyraclostrobin) foliar fungicide at 0.16 L/ac  (0.4 L/ha) label rate was also compared.

For dry bean, the nutrient foliar treatment applied was P3TM (5% Ca) at 0.25 L/ac (0.62 L/ha), and Parasol WG (copper hydroxide) was the fungicide/bactericide foliar applied at the label rate of 2 L/ac (4.9 L/ha) rate.

In wheat, the nutritional recovery product applied was Alpine G22 (6–22–2) at the 3 L/ac (7.4 L/ha) rate, and the foliar fungicide treatment was Prosaro XTR (prothioconazole + tebuconazole) at the label rate of 320 mL/ac (790.7 mL/ha).

Data collected included plant density, plant height, crop biomass, and normalized difference vegetation index (NDVI) one week after simulated hail damage to quantify the effects of damage on crop development. Grain yield and 1000-kernel weight were collected at harvest.

**Hail damage impacted crop growth**

Simulated hail significantly impacted plant height, NDVI and crop biomass at both timing and severity in each crop. In wheat, the reduction in NDVI was significantly higher for the early hail damage (12% and 19% for light and heavy damage, respectively) compared with the hail damage at the middle (7% and 10% for light and heavy damage, respectively) and late (5% and 8% for light and heavy damage, respectively) stages

NDVI was significantly lower for hail damage at early stage compared with the middle and late stages in field pea and dry beans. The NDVI decreased by 15% (light) and 18% (heavy) for field pea, and 9% (light) and 14% (heavy) for dry bean relative to the untreated control.

Wheat biomass decreased by 22% for light damage and 30% for heavy damage relative to the untreated control. Wheat biomass was significantly lower at the hail-damaged early and middle stages compared to the late stage. The interaction between hail timing and severity was not significant.

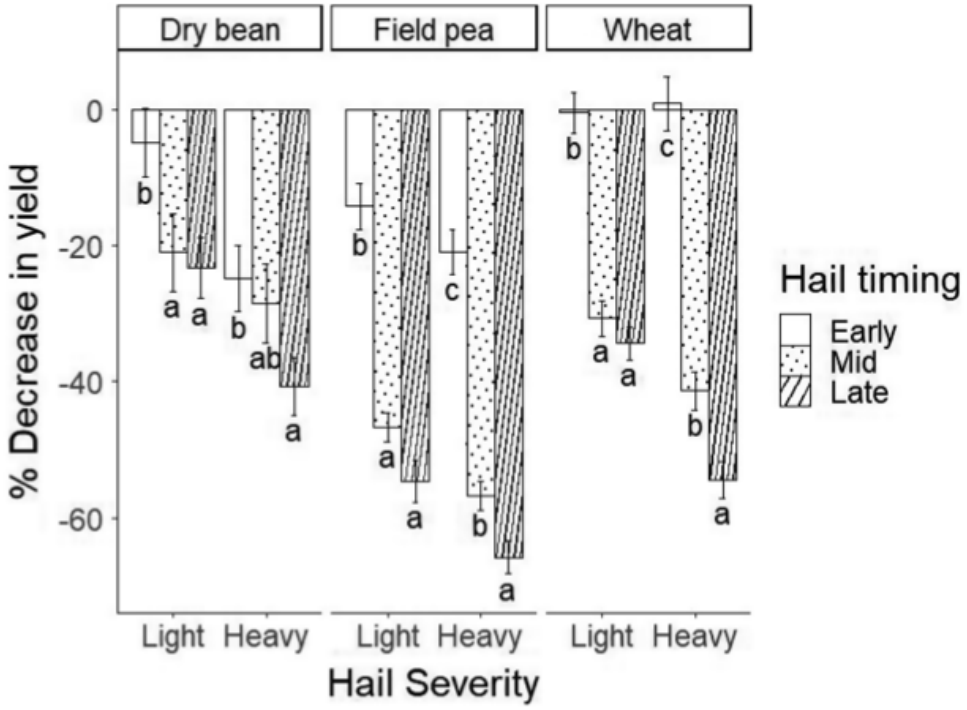
Crop biomass did not significantly decrease in field pea or dry bean relative to the untreated control at the early stage. At the middle and late stages, there was a significant decrease due to hail damage. Field pea biomass decreased 31% with light hail damage and 38% for heavy damage. In dry bean, biomass decreased 36% with light hail damage and 47% for heavy hail damage.

**Crop yield varied depending on timing and severity**

Both hail timing and severity significantly decreased seed yield, with a significant interaction between timing and yield in all crops. Yield reductions were the smallest at the earliest crop staging because the crop had more time to recover from the damage.

Overall, light hail damage decreased the average yield for wheat by 24% from 77 bu/ac (5200 kg/ha) for the untreated control to 59 bu/ac (3954 kg/ha) (24% decrease), and by 35% to 50 bu/ac (3377 kg/ha) for heavy damage. For wheat, early damage at the tillering stage did not significantly affect yield. Heavy damage at the flowering stage resulted in 55% yield loss.

**Change in yield (%) for the light and heavy damaged treatments compared with the untreated control**




Source: Dhillon et al. 2020

In dry bean, the untreated control yielded 38 bu/ac (2574 kg/ha), and decreased by 17% to 32 bu/ac (2138/ha) for light damage, and had a 35% yield decrease to 26 bu/ac (1745 kg/ha) with heavy hail damage. There was no significant reduction in yield for light hail damage at the early growth stage, but incurred a 41% yield decrease for heavy hail damage at the late growth stage.

Overall, light hail damage decreased field pea yield from the untreated control by 37% from 61 bu/ac (4082 kg/ha) to 38 bu/ac (2566 kg/ha). Heavy hail damage decreased yield by 45% to 33 bu/ac. During the early growth stage, light hail damage decreased yield by 14% and by 21% for heavy damage. The highest loss was 66% for heavy hail damage during the late growth stage.

Hail timing and severity also affected the TKW of the crops. In wheat, TKW decreased between 4 to 6% with light and heavy damage. The largest reduction in pea TKW was observed at mid-growth stage decreasing by 16% for light damage and 20% for heavy damage. In dry bean, there was a

reduction in TKW for dry bean with heavy hail severity at the early growth stage, but an unexpected increase in the TKW at both light and heavy hail damage during the late growing stage.

**Recover products not effective**

When applied as recovery products, nutrient blends and fungicides did not significantly improve stand density, crop height, NDVI, yield, and seed weight compared with the check. This result is similar to other studies that did not find an increase in yield in response to application of fungicides in hail-affected crops such as corn, soybean and dry bean.

Overall, based on simulated hail injury, the timing and severity of the damage will impact crop yield, and should be considered when assessing damage in hailed crops. Application of recovery products used in this research were ineffective and resulted in a net economic loss.

---

Funding for this project was provided by the Alberta Wheat Commission and Alberta Pulse Growers. The support of AFSC in the assessment of hail damage to crops is gratefully acknowledged.

Gurbir Singh Dhillon, Mike Gretzinger, Lewis Baarda, Ralph Lange, Kabal Singh Gill, Vance Yaremko, Michael W. Harding, and Ken Coles. Effects of simulated hail damage and foliar-applied recovery treatments on growth and grain yield of wheat, field pea, and dry bean crops. *Canadian Journal of Plant Science*. **101**(5): 758-769.

Open Access: https://doi.org/10.1139/cjps-2020-0231