Comparison of Ground and Aerial Application of Fungicide for Control of Ascochyta Blight in Chickpeas

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Abstract
Ascochyta rabiei control from aerial and ground application was assessed near Saskatoon in 2003 and 2004. Each year, a site of about 12 ha was seeded to kabuli (cv. CDC Xena) chickpeas. At the first sign of disease, applications of fungicide were commenced and maintained at approximately 10-day intervals. In 2003, four applications (two with Headline (pyraclostrobin), two with Lance (boscalid)) were conducted. In 2004, the last Lance application was not done. Aerial application was made using a Cessna AgTruck applying 37 L/ha using CP nozzles emitting a spray with a VMD of approximately 271 µm. Ground applications were conducted using a Melroe SpraCoupe applying 100 L/ha using XR8003 nozzles with a VMD of approximately 246 µm. Disease ratings were done throughout the season, and seed yields were taken at crop maturity. Disease incidence progressed to 80 to 90% in the untreated plots, and fungicide application reduced disease incidence (to 20 to 30%) and increased seed yield in both years. Disease incidence and seed yield were not affected by application method in either season.

Introduction
Fungicide application is an important disease management strategy for ascochyta blight (caused by *Ascochyta rabiei*) in chickpea due to the poor host resistance in available cultivars. Ascochyta blight, left untreated, can cause yield losses in excess of 90% in Saskatchewan, and appropriate timing and frequency of fungicide spray application is critical. Producers wishing to apply fungicide are sometimes unsure which application method to use – aerial or ground. Both offer potential advantages and disadvantages: ground sprayers utilize greater water volumes, but leave tracks which can lower yield and spread disease. Aircraft use lower water volumes but do not damage the crop and can cover more area in a timely fashion. The relative importance of these characteristics is unknown. Objectives of this study were to compare aerial and ground fungicide application on chickpea disease and seed yield.

Materials and Methods:
Chickpeas (certified CDC Xena, a unifoliate kabuli rated as having very poor ascochyta resistance) were seeded on May 15 (2003) and May 27 (2004) on 12-ha sites near Saskatoon which had been chem-fallow wheat stubble (2003) and spring wheat (2004) the previous year. Seed was treated with Crown and Apron and seeded at 190 kg/ha (35 seeds/m^2) to a depth of 6.5 cm using a Flexi-Coil air seeder with 22-cm row spacing. The field was harrowed and rolled after seeding. Pursuit (70 mL/ha) and Post Ultra (0.32 L/ha) were applied for weed control in

both years. The crop established evenly and weed populations (primarily prostrate pigweed and stinkweed) were low in 2003. In 2004, sow thistle was the predominant weed.

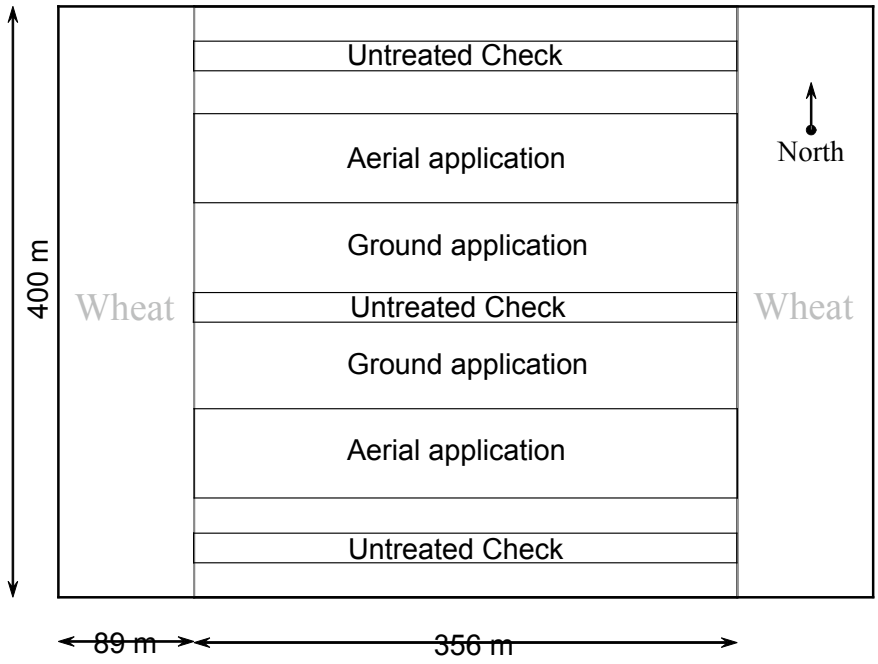


Figure 1: Field layout for trials.

The site measured 400 m x 356 m (2003) and 400 m x 267 m (2004) and was divided into two equal halves (replicates). Each of three treatments was established in each half: untreated check, aerial, and ground application. The aerial treatment consisted of four adjacent 15-m passes and the ground application was five 13-m passes per replicate. A control swath was left at either end of each replicate, but a sprayed buffer separated the control from a treatment to avoid disease spread (Figure 1).

In 2003, the crop was scouted at 5-day intervals for the presence of disease. Initial disease levels through June were very low and disease did not become visible until after the first major rainfall event on July 6. Headline (pyraclostrobin) was applied on July 11 and July 21 at 0.4 L/ha, followed by Lance (boscalid) on August 1 and 13-14 at 0.42 kg/ha. Aerial and ground applications were conducted at dusk with calm conditions. Both were conducted within 1 h of each other except for the last application of Lance where the ground application followed the next morning.

In 2004, the crop was slow to establish due to cool temperatures, disease became prevalent early in the crop development, especially on the side of the field which bordered the 2003 trials. Headline was applied on July 12 and July 23, Lance was applied on August 2.

In both years, aerial applications were done by Cessna Ag Truck applying 37 L/ha through 24 CP-03 nozzles with the 0.125 flow orifice and 90º deflection, at a pressure of 234 kPa and 192

km/h airspeed. At these settings, the spray had a volume median diameter (VMD) of 271 µm according to USDA atomization models. Boom height was 3 to 4.5 m above ground (Figure 2).

Figure 2: Aerial and ground application of fungicide to chickpeas.

Ground applications were done using a Melroe SpraCoupe 220 travelling 13 km/h, using XR8003 nozzles operated at 275 kPa and a boom height of about 75 cm. At these settings, the application volume was 100 L/ha, and the spray had a VMD of 246 µm (Figure 2).

Disease symptoms became evident in early July in both years. Ratings were conducted near the spraying dates using the 0-11 Horsfall-Barratt scale, converted to % infection. Single plants were rated at 64 (2003) and 60 (2004) locations in each treatment within each rep, for a total number of 128 or 120 plants rated per treatment per rating date (except for the first rating, where only 24 plants per treatment were rated). Ratings from the outside two passes of the aircraft in each replicate were deleted since proper spray patterns were not expected at these edges.

Figure 3: Ascochyta blight symptoms on chickpea leaves. Early infection (left); advanced infection showing lesions with pycnidia (right).

In 2003, the crop matured in mid-August and Reglone was applied by ground sprayer travelling perpendicular to the treatments, on August 22. In 2004, the crop failed to mature and was sprayed in a similar fashion with Roundup on September 20.

The 2003 crop was harvested on September 3 using a Case 1688 combine with a 9-m flex header (Figure 4). After removal of headlands, two 275 m long swaths were taken from each treatment, and the seed from each swath was weighed and sub-sampled for seed quality. In the aerial plots, the central two spray swaths of each rep were sampled. In the ground plots, two swaths were taken with wheel tracks, and two without wheel tracks in each rep. Wheel tracks were then adjusted to a 90' boom width for yield calculations.

Figure 4: 2003 sprayer tracks (left) and combine operation (right). Harvested seeds in insert.

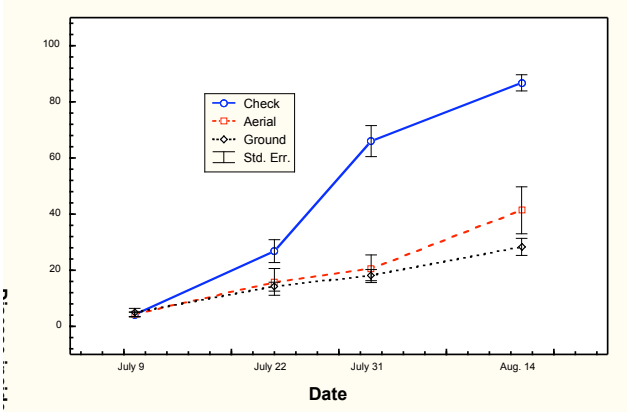
In 2004, harvest was impractical with the large combine due to the low seed yield and quality which prevented accurate yield measurements. On November 10, a Hege combine was used to harvest a single pass along the length of each sprayer swath for all treatments. The grain was bagged, dried, and weighed.

All data were analyzed using analysis of variance (ANOVA) as a randomized complete block design with two replicates. Treatment effects were considered significant at p=0.05.

Results and Discussion:

Ascochyta was prevalent in both 2003 and 2004. In 2003, disease incidence in the untreated chickpea progressed from about 5% to about 66% from July 9 to July 31. Disease incidence in sprayed plots was significantly less, about 18 and 21% for the ground and aerial treatments, respectively on July 31. A late flush of disease on new growth increased levels to 87% in the untreated plots, and 28 to 41% in the ground and aerial plots, respectively, on August 14 (Figure 5, left).

In 2004, disease in the untreated plots steadily increased from 3% infection on July 14 to 99% on Sept 14. During this time, the treated aerial and ground plots increased from 4 to 18-20%, similar for both application methods (Figure 5, right).



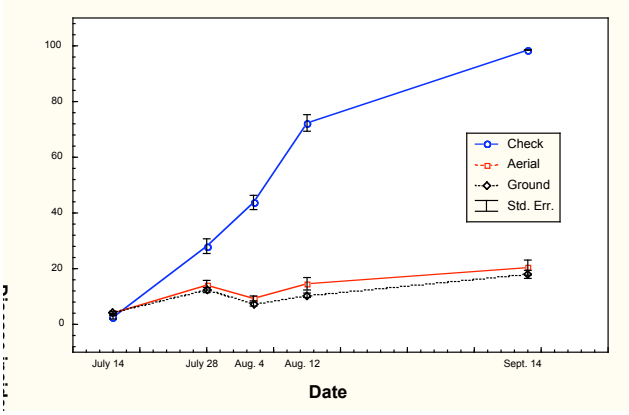
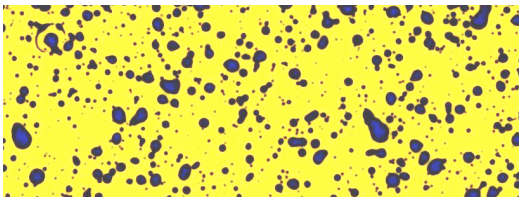


Figure 5: Ascochyta blight incidence on chickpeas throughout growing season. 2003 (left), 2004 (right).

Application methods generated visually different spray deposits on water sensitive cards (Figure 6). The ground application had greater overall coverage of the cards primarily due to the greater water volume used (100 L/ha vs. 37 L/ha). Cards indicated that overall uniformity of the spray deposit along the width of the boom was greater for the ground sprayer (data not shown). However, water sensitive cards provide an artificial collection surface that does not accurately simulate the complexity of a leaf surface or a multi-dimensional plant canopy. These cards therefore do not provide an assessment of leaf coverage, but are limited to a visual indication of the type of spray quality emitted by the application.



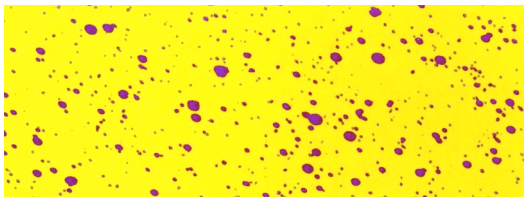


Figure 6: Spray deposit on water-sensitive paper for ground application at 100 L/ha (left) and aerial application at 37 L/ha (right).

Fungicide application significantly increased seed yield in both years. In 2003, yield averaged 13 bu/acre for the unsprayed treatments, and 33 bu/acre where fungicides had been applied. Aerial treatments yielded 32.7 bu/acre, whereas ground treatments (track damage adjusted for 90' boom width) yielded 34.4 bu/acre. This difference was not statistically significant (Table 1). Ground-sprayed areas without wheel tracks yielded 36.0 bu/acre, therefore yield loss due to tracks was 1.6 bu/acre (Figure 7).

Table 1: Analysis of variance results for chickpea seed yield from aerial and ground applications (ground with tracks adjusted for 90' boom), 2003.

Effect	df Effect	MS Effect	df Error	MS Error	F-value	p-level
Treatment	1	5.89	1	1.41	4.18	0.290
Replicate	1	12.10	1	1.41	8.58	0.209

Sprayer tracks reduced yield due to crop destruction, but they did not appear to spread disease within the crop. It is possible that application during evening hours before dew wetted the foliage helped prevent disease spread. The role of sprayer tracks requires further investigation.

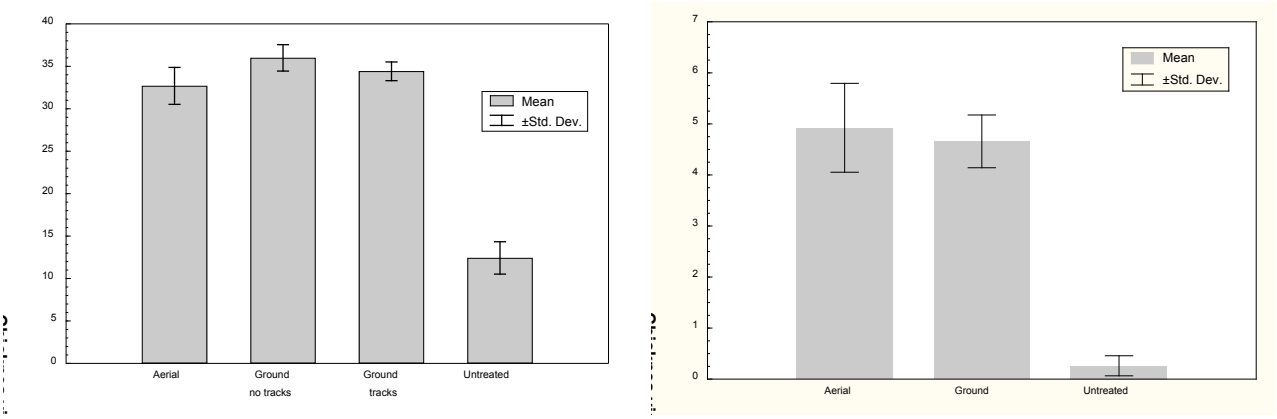


Figure 7: Chickpea seed yield in plots treated with fungicide applied by air and ground. 2003 (left), 2004 (right).

Seed yield and quality were very poor in 2004 due to cool growing conditions and an early frost. In spite of this, results mirrored those from 2003: fungicide applications significantly increased yield, from 0.3 bu/acre in the untreated plots to 4.7 and 4.9 bu/acre in the ground and aerial treatments, respectively. Yield differences arising from application method were not statistically significant.

Seed quality analysis demonstrated no difference in chickpea grade between ground and aerial applications. *Ascochyta rabiei* was not detected on seed from any treatment in 2003.

These results showed that both ground and aerial application of fungicide provided effective control of *Ascochyta rabiei* on chickpea. Results from 2004 were compromised by a poor growing season, therefore further work may be necessary to confirm this outcome. Nonetheless, the consistency of conclusions support recommending both methods to producers wishing to apply fungicides.

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