Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

GRDC™ GRAINS RESEARCH & DEVELOPMENT CORPORATION

Optimising fungicide-use for chocolate spot management in faba beans

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Key messages

- Seasonal conditions during 2020 were not conducive to chocolate spot development and no significant yield difference was measured between fungicide spray regimes.
- Unnecessary application of fungicides reduces gross margins.
- Real-time IoT sensors (data loggers) used for crop microclimate monitoring can support timely fungicide use and reduce unnecessary prophylactic sprays.
- Further trials are required in disease-conducive seasons to increase confidence in the use of this technology for spray decision support.

Aims

To compare the effectiveness of fungicide regimes on disease management in faba beans, including a regime based on an 'Internet of Things' (IoT) sensor that uses canopy microclimate data.

Background

Growers in the southern high rainfall zone are branching out into faba bean production. Feedback from these growers and local agronomists suggests a lack of confidence and experience in disease management due to perceptions based on varieties widely grown 20−30 years ago that were highly susceptible to chocolate spot. Furthermore, protecting faba beans from disease through the use of fungicides is one of the most costly inputs over the season, so reducing ineffective spray applications could increase growers' gross margins.

Researchers have determined the ideal conditions for the chocolate spot pathogen (*Botrytis fabae*) to infect faba beans are 12 consecutive hours of temperatures over 15°C and 70% relative humidity (RH). By monitoring canopy microclimate and transmitting data every hour, a simple model calculates the risk of infection and sends real-time spray alerts by email.

Method

A small plot trial was set up at Kojaneerup in an evenly-established faba bean crop where plots were marked out in August 2020. The paddock was dry sown by the grower on 28 April (opening rains 6 May) and managed as normal. The grower sprayed mancozeb in June to protect vegetative growth but following this, the trial area was excluded from all subsequent sprays by the grower. Sixteen trial plots and five buffers measuring 12m by 1.5m were pegged, consisting of four experimental treatments replicated four times and randomised (Table 1). The products used and application timings are in Table 2.

Table 1. Four planned trial treatments. These were adjusted due to seasonal conditions and are displayed in the table as fungicides applied.

Treatment	Fungicides planned	Fungicides applied
1. Control	No fungicide	**No fungicide**
2. Farmer practice	2x sprays during flowering	**Spray 1** during flowering
3. Early and often	3–4x sprays during flowering–podding	**Spray 1+2+3** during flowering–podding
4. Crop canopy sensor alert	Spray when alerted (as Spray 1+2+3)	**No fungicide** (no alert)

Table 2. Fungicide active ingredients and spray timings.

	Fungicide active ingredient	Date	Crop growth stage
Spray 1	Carbendazim (Spin Flo 500mL/ha)	07/08/2020	BBCH55 – Flower buds visible
Spray 2	Tebuconazole + azoxystrobin (Veritas 1L/ha)	21/08/2020	BBCH65 – Full flowering
Spray 3	Carbendazim (Spin Flo 500mL/ha)	09/09/2020	BBCH70 – First pods visible

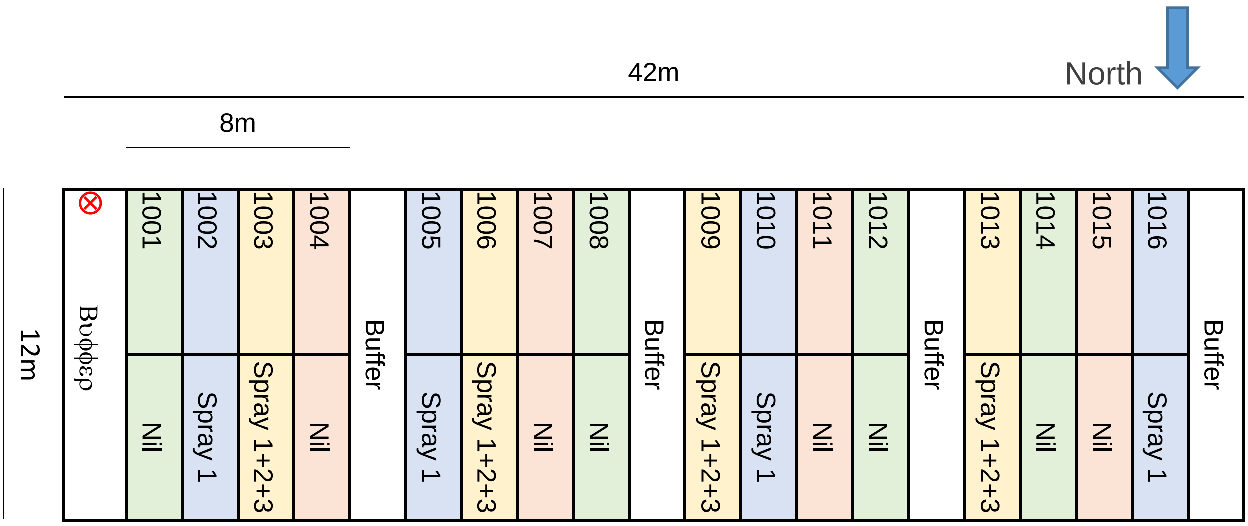

Figure 1. Trial layout showing randomisation of treatments. Red cross indicates data logger location.

Data logger

A data logger (DataEffects, South Australia; Figure 2) was set up in the northeast corner of the trial in a buffer plot (Figure 1), where the crop canopy was dense. Sensors were positioned in the crop canopy to measure air temperature and humidity, and a 0−10cm soil moisture probe was buried in the topsoil. Power was supplied by a 5W solar panel and an internal rechargeable lithium-ion battery. The sensor and solar panel required repositioning once as the crop grew taller (Figure 2). Data was relayed hourly via Telstra narrow-band IoT network. It was programmed to send spray warnings when specified conditions were recorded for eight hours, and send spray alerts after 12 hours. As a spray alert was never issued, Treatment 4 was not sprayed, thus the data were grouped with Treatment 1 (nil fungicide) for analysis.

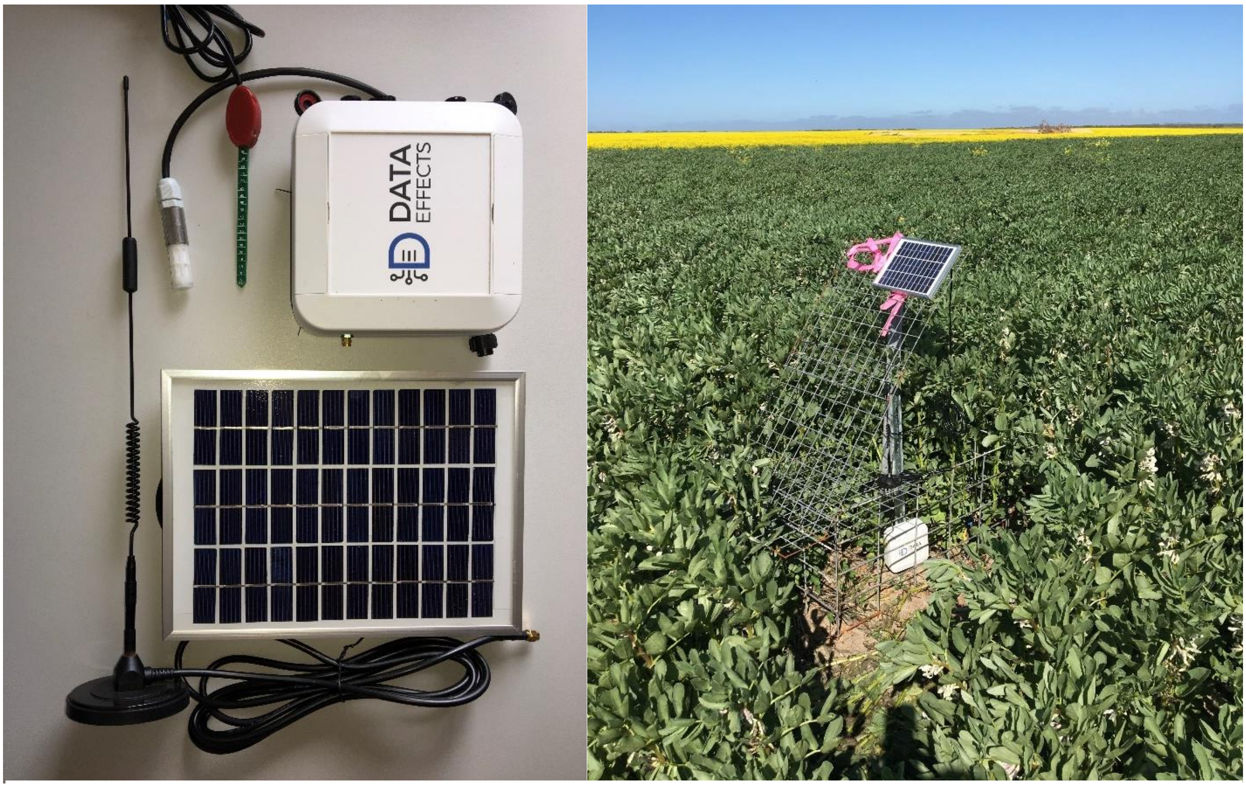

Figure 2. Data logger equipment from DataEffects and set up in paddock. Sensors were placed within the crop canopy.

Measurements

Soil samples were collected in July for analysis by CSBP (Table 3) and SARDI (Predicta B). The soil is described as grey sand (0–10cm) over sandy gravel (10–30cm) over clay (30–50cm). High levels of crown rot were detected, which does not affect faba bean plants. The paddock had been limed and deep ripped to 50cm with inclusion plates prior to sowing.

Table 3. Soil characterisation at field trial location

Depth	Gravel	OC	pH in $CaCl_2$	EC	Ammonium N	Nitrate N	Colwell P	Colwell K	S	PBI
cm	%	%		dS/m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
0-10	5	1.61	6.1	0.123	6	15	26	119	11.7	20.0
10-20	55-60	0.81	4.9	0.070	7	9	21	84	8.7	16.9
20-30	75-80	0.57	5.6	0.056	4	5	9	131	5.2	31.0
30-40	5	0.59	5.9	0.074	4	5	5	306	6.3	101.6
40-50	5	0.55	6.2	0.083	5	5	5	434	7.4	214.8

Foliar disease incidence was scored on four occasions; on 20 August (before the first spray), 28 August, 15 September and 6 October (approximately one week after fungicide sprays). Disease was scored on a scale from zero (no symptoms) to nine (extensive lesions, severe defoliation, death of 80% of plants). Plots were harvested on 17 December and yield data recorded.

Results

Season

The 2020 season was ranked a decile 3 at Kojaneerup (295mm April–October), based on DPIRD's Rainfall to Date tool. The crop was under moisture stress early in the season. The season break (15.4mm over three days) was on 6 May, followed by a dry June and July, with the largest rainfall in July just 1.8mm. Then 100mm fell over two days in early August. Dry and windy conditions meant that moisture was limited, and quickly evaporated reducing leaf-wetness and canopy humidity. The season was not conducive to chocolate spot development and almost no foliar disease was observed. Plants along the northern edge of the trial were affected by cowpea aphids from mid-August onwards. Plot lengths were adjusted to 9.9m for harvest to avoid this effect.

Disease incidence

Overall, disease scores ranged from 0 (no disease) to 3 (few small discrete lesions, but no defoliation). Analysis of variance was performed on disease scores for each measurement occasion with no significant difference between spray regimes until the October measurement ($p>0.05$). Disease scoring on 6 October showed the unsprayed plots had higher disease incidence than the sprayed treatments ($p=0.015$). Treatments that had one fungicide spray and three fungicide sprays both had an average disease score of 1 (very small specks on leaves). Treatments that had no fungicide (nil and data logger treatments combined) had an average disease score of 2.12. While statistically significant, this difference is practically insignificant for grower decision-making.

Yield

The average trial yield was 2.75t/ha, though the grower reported a paddock average of 1.7t/ha. Yield did not differ significantly between treatments ($p=0.256$, $LSD_{5\%}=0.34$t/ha). The range in yield between treatments was low (Figure 3), as expected due to the lack of disease pressure with only 0.29t/ha between the lowest (one spray) and highest (three sprays) yielding treatments.

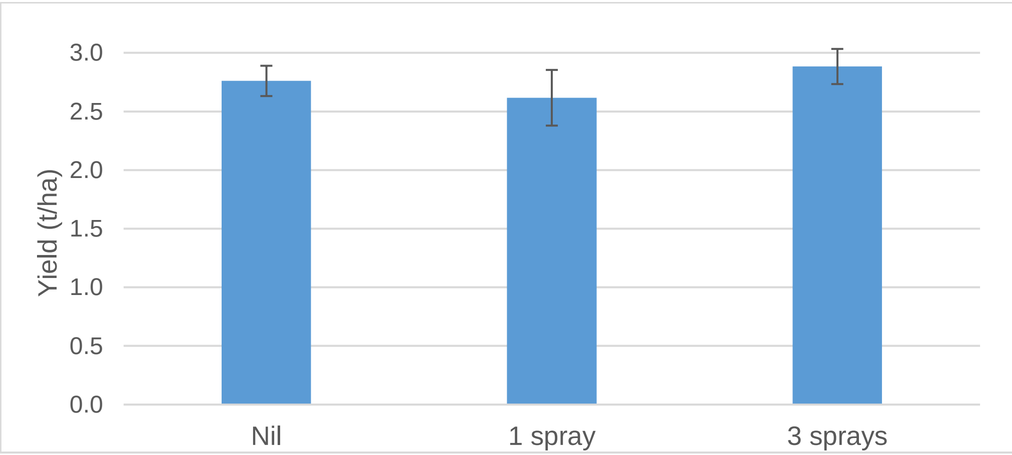

Figure 3. Faba bean yield under different fungicide spray regimes. Error bars represent one standard error of treatment means.

Conclusion

This trial aimed to compare the effectiveness of fungicide regimes on disease management in faba beans, including a regime based on an IoT sensor that uses canopy microclimate data. Seasonal conditions were not conducive to a chocolate spot outbreak so the opportunity to investigate this technology was limited. This 'agtech' has potential to increase the profitability of the break crop rotation by supporting disease management decisions and reducing unnecessary spray applications. In this season the technology was successful in providing support not to spray where otherwise a grower may have applied a programmed fungicide that was unnecessary.

In this season, there was no practical difference in disease incidence whether faba beans were sprayed with fungicide or not. There was no significant difference in yield between spraying and not spraying. However, it is possible that if a late fungicide spray increased yield up to 290kg/ha, this could increase gross margins depending on grain prices. More research is needed on the effect of late fungicide application in faba beans where disease pressure is low.

References

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Acknowledgments

Thank you to Goad Farming for hosting this trial, and to Mark Seymour, Stacey Power and Jeremy Lemon for their advice; and to DPIRD and GRDC for their co-investment in this project.

'Building crop protection and crop production agronomy research and development capacity in regional Western Australia' project − a joint investment by DPIRD and GRDC (DAW00256/DAW1512-001RTX)

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