

MAPPING ONION CROPS: IMPLICATIONS FOR NITROGEN MANAGEMENT

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Background

In 2014 we developed a process by which a smartphone captures canopy images and processes them at least once per second to determine percentage groundcover. The result is linked to a GPS position and logged. The collected data can be viewed as a kml image on the phone on a suitable mapping application, or passed to a GIS programme for further processing.

Through the Onions New Zealand - MPI Sustainable Farming Fund project, “Enhancing the profitability and value of New Zealand onions” (SFF Project No. 408098), we have applied the mapping process to help understand field scale variability in onion crops.

Four years’ experience mapping onion crops gives confidence that image analysis provides a reliable method to assess canopy development. Crops can be readily surveyed at three leaf stage using tractor mounted equipment. The collected canopy data correlate very strongly with laboratory measurements of fresh leaf mass and leaf area index (LAI).

We have used ArcGIS to interpolate the collected data and produce stratified zone maps of apparent ground cover with canopies zoned into three or four bands. These provide a basis for selecting further sampling plot sites.

A supporting model of Management Action Zones based on canopy development and plant population has been developed. Ground cover assessments are combined with population counts to classify if the crop is at a potential or if it is limited by growth, population or both.

Work to use the survey and population data for yield prediction is ongoing. A critical factor is relative growth stage, which we measured by observed leaf number. Recent yield prediction results suggest an alternative such as potential leaf number determined from experienced growing degree days may be better.

From four years of maps at the LandWISE MicroFarm we have evidence of areas that are stable high growth and stable lower growth. This indicates soil effects, and although the actual causal factors have yet to be identified, drainage and soil physical properties are implicated.

How should management respond to areas of canopy variation?

Using Maps to Guide Management Decisions

We used the canopy maps and zones to question management decisions including agrichemical and fertiliser management.

Agrichemical (disease) management

Our 2017-18 season had a period of high disease risk with few opportunities to apply agrichemicals. We observed that disease (mildew) established most quickly and severely in the areas of greatest canopy. We know where these areas are and to scout them most intensively. We are considering if the difference in canopy is sufficient to warrant variable rate application.

Fertiliser (nitrogen) management

We used the canopy mapping data to identify areas where canopy was consistent. We selected a bed where the canopy was large and an adjacent bed where the canopy was significantly smaller. We established trials to compare fertiliser timing and rate.

Issue 1: Applying nitrogen early may increase risk of leaching if not taken up by the developing crop.

Plant and Food Research trials have found only about 20% of total nitrogen uptake by onions occurs before the onset of bulbing. Growers have told us they have applied much if not all their crop nitrogen by then. Nitrate test strips can be used in-field to quickly and cheaply determine the amount of available N, giving confidence that fertiliser application can be delayed or reduced.

In a full canopy area, supported by Quick Test assessments of available nitrate-N, we compared “standard” fertiliser timing with delaying any application until bulbing.

At five leaf stage (after many growers have applied fertilisers) we took soil cores from each of eight plots and performed Quick-test Nitrate assessments of available N. We found there was still about 35kg/ha of unused Nitrate available to our crop in the plots.

- On 11 November (five leaf stage) we applied 40 kg/ha fertiliser N as sulphate of ammonia (SOA) to half the plots (“standard timing”) and none to the others (“late timing”).
- On 8 December all plots received 60kg/ha N as Yara Mila Faster. The “late timing” plots also received 40 kg/ha N as SOA.
- On 9 January all plots received a further 30 kg/ha N as Yara Mila Complex.

At crop lifting, bulbs were counted and weighed and soil N tests again undertaken using the Quicktest N method.

Issue 2: Applying excess nitrogen may reduce storage quality and increase leaching risk. There is some indication it may be associated with increased disease susceptibility. A smaller crop requires less nitrogen than a corresponding large crop.

In a zone where canopy cover was limited we selected 16 plots and trialled half fertiliser rates against standard practice rates. The “standard rate” fertiliser programme was applied as for the “standard timing” described above. The half rate programme retained the timings but only half rates were applied.

At crop lifting, bulbs were counted and weighed and soil N tests again undertaken using the Quicktest N method.

Results

The data from both trials were combined and evaluated. Results are shown in Table 1.

Table 1 Comparison of fertiliser timing and rate on full and reduced canopy onion crops.

Treatment	Soil N at start (kg/ha)	Soil N at finish (kg/ha)	N removed (kg/ha)	Yield (t/ha)	N removed (kg/tonne)
Large Canopy Standard Timing	36.4	43.2	121	54.9	2.21
Large Canopy Late Application	34.1	41.0	121	57.9	2.10
Small Canopy Full Rate	39.2	59.2	107.9	45.6	2.37
Small Canopy Half Rate	34.1	45.5	52.4	44.7	1.19
sig	P = 0.404	P = 0.15	P = 0.001	P=0.006	P = 0.001
LSD	6.73	15.4	19.9	6.63	0.49

Soil Nitrate at start and finish

At five leaf stage - the start of the trial available soil nitrate as assessed using the QuickTest strips showed no difference between treatments.

At harvest - the end of the trial:

- Yields were significantly higher in the large canopy plots

- There was no yield difference in large canopy plots resulting from fertiliser application timing
- There was no yield difference in small canopy plots resulting from fertiliser application rate
- There was no residual nitrate difference in large canopy plots resulting from timing treatments
- There were higher levels of residual nitrate in small canopy plots than in large canopy plots
- There were higher levels of residual nitrate in small canopy plots that received the full application rates than those that received half application rates
- There was significantly less nitrate removed per tonne of onion yield in small canopy plots that received half application rates.

Conclusion

On the basis of this initial trial work, growers can delay fertiliser application without affecting yield. The nitrate test strips provide a method to check sufficient soil nitrogen is available to the crop.

Matching application rates more closely to expected yield may reduce fertiliser cost and leaching risk without impacting yield. Effects on quality are yet to be determined.