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INTENSIVE VEGETABLE PRODUCTION: FERTILISER APPLICATOR CALIBRATION

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Abstract

As part of the Sustainable Farming Fund project, "Future Proofing Vegetable Production", we assessed the performance of fertiliser application equipment used in vegetable growing operations in Gisborne and Levin. Direct placement of fertiliser (either by planters, side-dressers or from modified tail-wag spreaders) is much more common than broadcast application in these growing systems. To collect and process data from a variety of different spreaders, we propose a set of data collection protocols and analyses. A spreadsheet calculator created to process data and prepare reports for growers evolved as we gained experience with equipment and through our engagement with growers. We want assessment to be valid and reporting to be meaningful.

We now have a Placement-Applicator Calibration Calculator that determines the rate of fertiliser being applied, the evenness of application across different outlets and consistency between tests. The variability of the placement applicators we tested has varied quite markedly from 0.8% CV to 24.8% CV. These are both within the SpreadMark accepted performance for broadcast spreaders applying non-Nitrogen fertilisers, and the majority of placement applicators tested were below the SpreadMark 15% CV limit for applying nitrogen-based fertilisers. With the knowledge that direct placement can be much more accurate than broadcast spreaders, what performance metrics are appropriate?

The Testing Process

We tested 11 fertiliser applicators, the FertSpread protocol was followed for the 2 broadcast spreaders tested; 9 were direct placement, so buckets placed underneath each outlet captured the applied rate. A test protocol and calculator tool were developed for fertiliser placement equipment with multiple outlets. The calculator outputs have been designed to improve nutrient management practices by reporting:

- Applied Rate compared with Target Rate (kg/ha)
- The Coefficient of Variation (CV%)
- Application Rate Consistency between tests

The Equipment

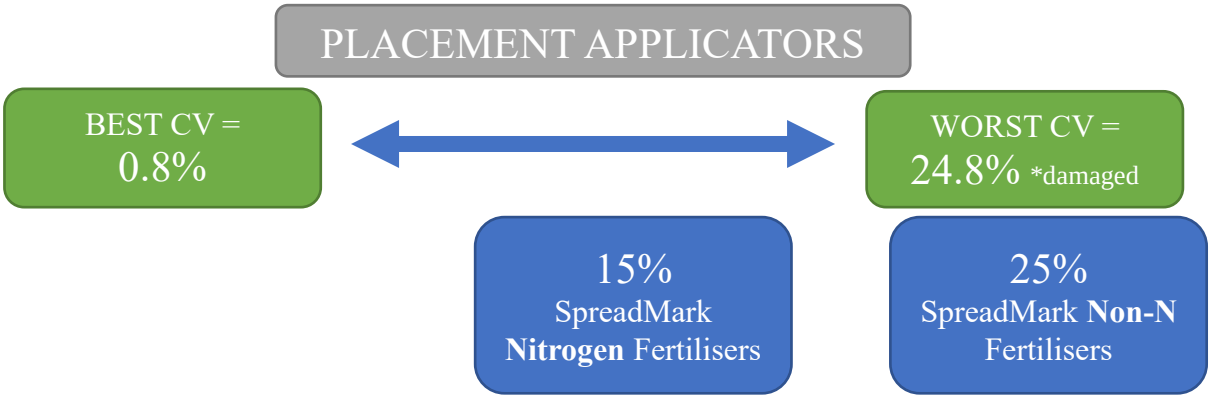
Figure 1 shows an example of a banding side-dresser, which was the most common type of equipment tested (comprising 5 of the 9 placement applicators). The fertiliser is banded between crop rows several times throughout the growing season.

Figure 1. Image and fertiliser placement pattern of a 2-outlet side dresser.

The Results

Figure 2 shows the range of CV% for the placement applicators tested. 8 of the 9 placement applicators were within the 15% SpreadMark limit for applying nitrogen fertilisers. The least uniform applicator (24.8%) represents a machine that was later found to have mechanical damage. The 2 broadcast spreaders tested had much higher CVs of 26.4% and 50.9% however, when the FertSpread analysis is considered, these could be brought down to 12.9% and 26.1% respectively, if bout widths were reduced by a small amount. Adjusting settings would probably achieve adequate performance in these spreaders.

Figure 2. CV% range of placement fertiliser applicators tested.



Sources of Variation

The types of variation contributing to overall CV% fall into three categories: Test Variation, Outlet Variation, and Application Rate Variation. The most extreme examples of these types of variation are shown in figures 3 – 5.

Figure 3. Fertiliser Applicator showing Test Variation.

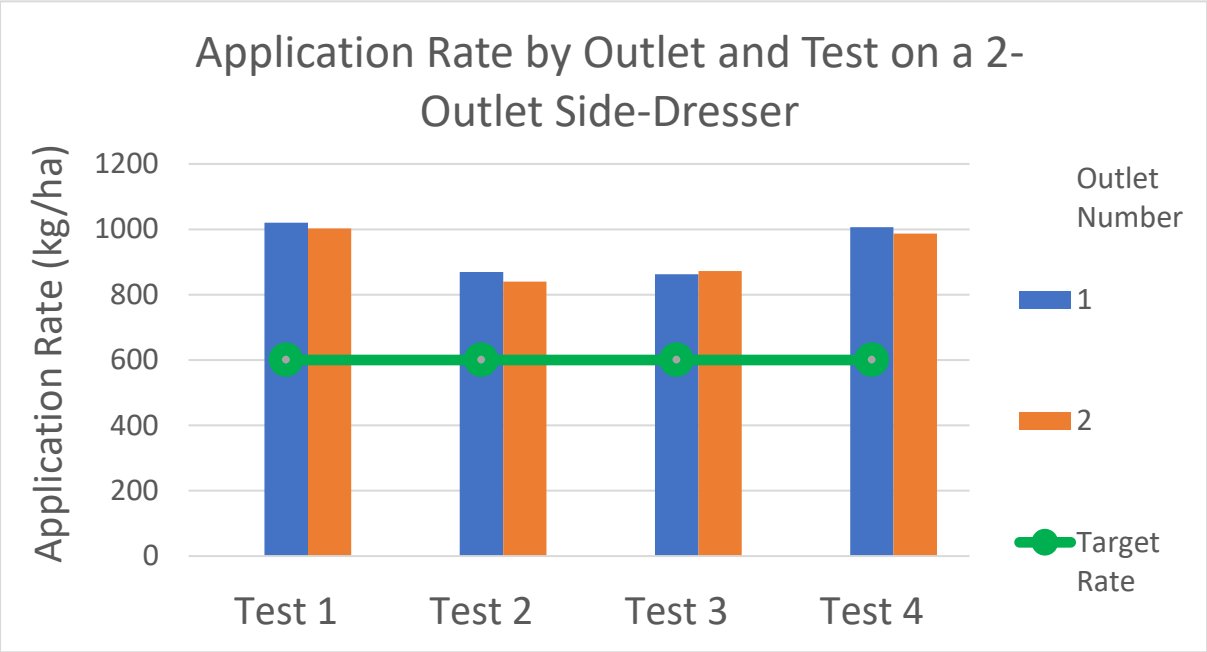
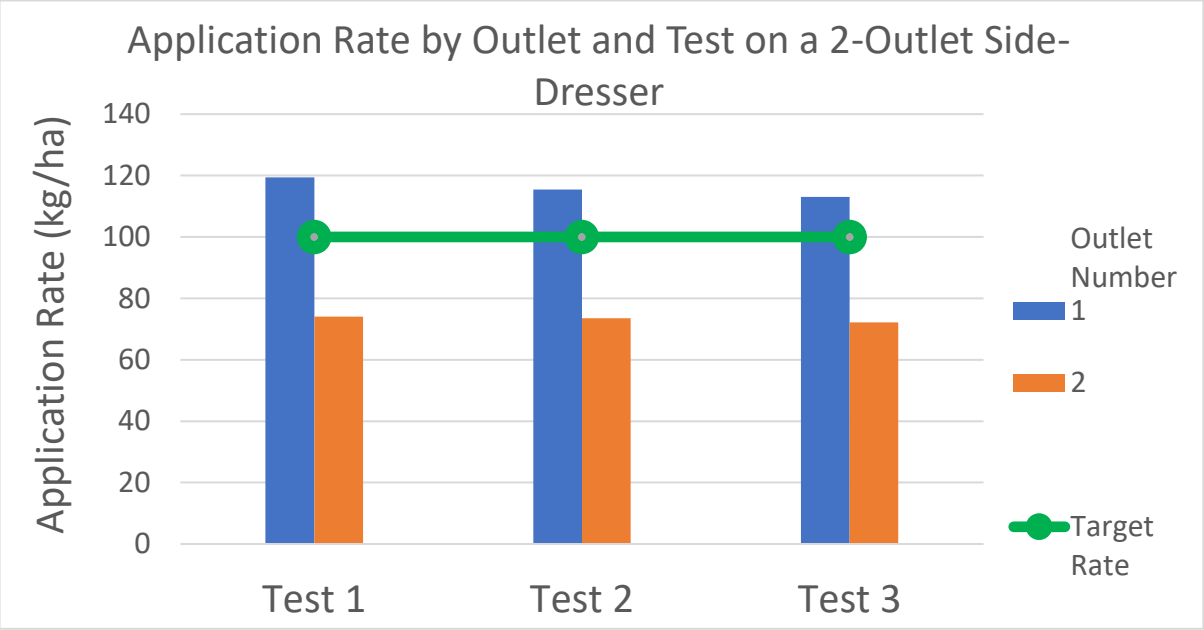


Figure 3 shows that the outlets 1 and 2 are very even (Mean Outlet CV = 3.1%), however there is much greater variation in this machine between tests (Average Application Rate in Test 2 was 18% less than in Test 1) This example demonstrates an old placement applicator, which has a manual hopper opening lever, which had developed a variable output over time due to general wearing.

Figure 4. Fertiliser Applicator showing Outlet Variation.



The fertiliser applicator machine tested (shown in figure 4), demonstrates variation due to outlet application differences. In this example, the outlet variation accounts for almost all of the total 24.8% CV. The applicator was found to have mechanical damage, and variation was significantly reduced once repaired.

Figure 5. Fertiliser Applicator showing Under-Application.

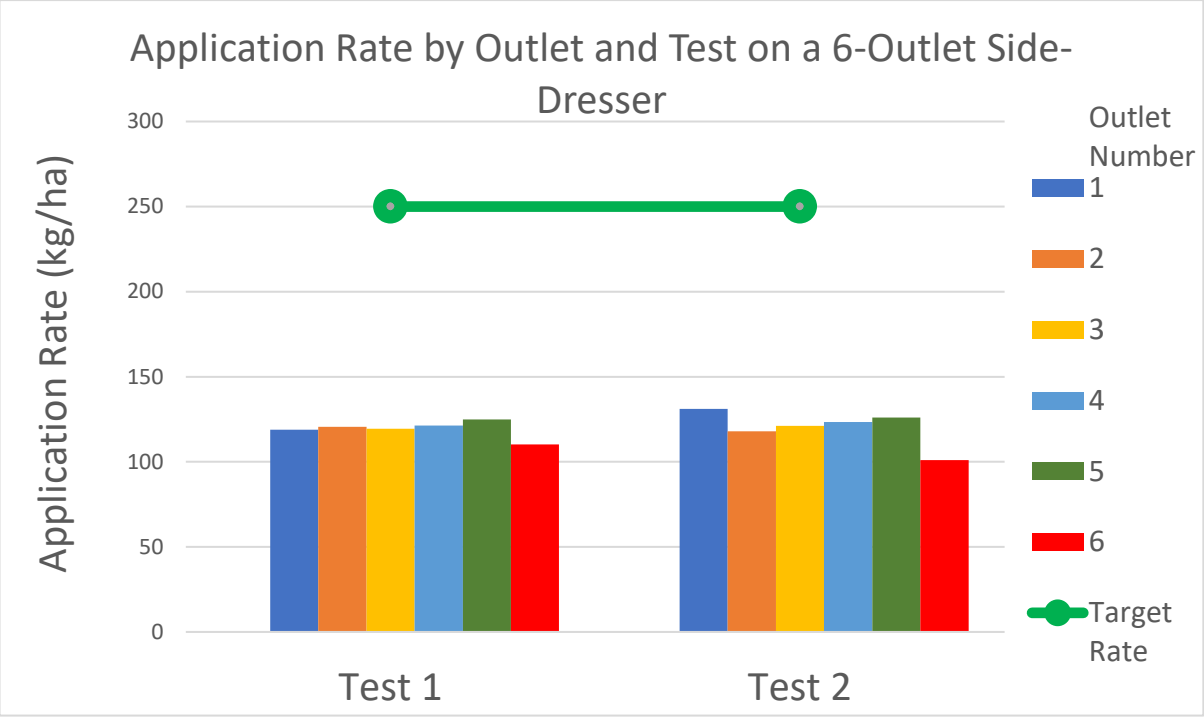


Figure 5 is an example of variation between application rate and target rate. The outlets are applying fertiliser evenly and the two tests have similar overall application rates, however the average application rate is 52% below the target application rate.

Conclusion

It is unclear what level of variation in fertiliser placement is acceptable in vegetable crops as the SpreadMark CV limits of 15% and 25% were developed based on striping seen in arable crops after broadcast applying fertiliser. There are multiple types of variation, which can be caused by improperly cleaned, poorly maintained, or worn machinery. From the data obtained in this trial work, the authors will be investigating the effect of varying fill level and fertiliser product density on application rate in a series of field days. Furthermore, the calculator developed during trial work will be refined and adapted to a website or mobile app format, improving it's accessibility. There is much to be learned through carrying out calibrations with growers, and engagement built throughout the project has been extremely beneficial to overall uptake of best practice guidelines for fertiliser use.