ON-FARM FERTILISER APPLICATOR CALIBRATION

Dan Bloomer

LandWISE, Hastings, dan@landwise.org.nz

The "On-Farm Fertiliser Applicator Calibration" project arose from repeated requests by farmers for a quick and simple way to check performance of fertiliser spreading by themselves or contractors. They are aware that different products behave differently on different days and with different machine settings. They wanted to know that spreading was acceptable.

Fertiliser applicator manufacturers provide guidelines to calibrate equipment but usually only the bulk application per hectare is determined, not the uniformity of application. This is a critical omission, as poor distribution significantly impacts yield and increases risk of leaching losses.

The Code of Practice for Nutrient Management is commonly referenced by Permitted Activity rules in Regional Plans, and *Spreadmark*® is increasingly being mooted as a requirement by some regulatory bodies. But to date *Spreadmark*® is neither designed nor suitable for many on-farm applications.

Fertiliser application calibration procedures suitable for farmers applying nutrients with their own equipment will allow on-farm checks to ensure and demonstrate application equipment is performing to expectations. They may also aid the self-audit component of *Spreadmark*®.

Interactions between the form and condition of fertiliser and the type of application equipment can have serious effects on the evenness and accuracy of application. Different products, and even different lines or batches of the same product, vary in bulk density. Factors such as slope, ground evenness, air humidity and wind speed also affect fertiliser spreading performance. To account for this, equipment must be calibrated.

There are many protocols internationally relating to the spreading of fertiliser products. The most common and relevant to New Zealand were reviewed by Lawrence (2007) who compared six test methods including:

- ISO Standard (i) (ISO 1985)
- ISO Standard (ii) (ISO 1985)
- ASAE Standard S341.2, (ASAE 1999)
- European Standard (CEN 1999)
- Accu-Spread (AFSA 2001)
- Spreadmark (NZFQC 2006).

Most of these test methods used 0.5 m trays organised in a single transverse row to capture the spread pattern of the spreader. Only Accu-Spread relies on more than one row during a test. No account is taken of the longitudinal variation between individual rows when multiple tests are carried out. The results of the test are given as the bout width where the coefficient of variation (CV) does not exceed a specified level. In all cases the maximum allowable CV is 15% for nitrogenous fertilisers and 25% where low analysis fertilisers are used.

A spreader should be able to be adjusted to spread a number of different fertiliser products. This is taken into account in some testing schemes but not others, as noted in Table 1.

Figure 1: 1400 tray matrix used to collect 18 simultaneous transverse tests on a Transpread "W" twin chain spreader (Lawrence 2006)

Table 1: Test requirements for six international fertiliser spreader performance testing

	Standard Tray Size	Tray Frequency	Transverse Spacing	Max Windspeed m/s	Number of Products Tested	Application Rates to Test	Statistical Quality
ISO 5690/1 (World)	0.5 × 0.5 m	Enough to cover total distributing width	Continuous	2.0	3	600, 400 & 150kg/ha	3
ISO 5690/2 (World)	0.25 × 1.0 m [a]	Enough to cover total distributing width	Continuous	2.0	3	600, 400 & 150kg/ha	3
ASAE S341.3 (USA)	> 0.3 m < 10% swath width	10 per swath	Uniform spacing	2.2	1	Typical/average	4
ES (Europe)	0.5 × 0.5 m	224 per 56 m (2 rows fixed)	Continuous	NA	6	-	2
Accu-Spread (Aus)	0.5 × 0.5 m	50 (2 rows 50 m apart)	1.0 m centre to centre	2.78	1	600kg/ha	1
Spreadmark (NZ)	0.5 × 0.5 m	60 per 30 m	Continuous	NA	3	Typical/average	3

Jones, Lawrence & Yule, 2007 used the data to estimate the confidence limits of the spread patterns for each international spread test and then to estimate the accuracy of correctly certifying the bout width. They found the ACCU Spread (Australia) method proved far superior in both estimating the confidence limits of the spread patterns for each international spread test and estimating the accuracy of correctly certifying the bout width.

There are differences between testing a type of machine, testing a single machine's capability and testing the performance of a specific machine with a specific product on a specific paddock under specific conditions.

Farm spreading equipment has seasonal use with potentially long periods of storage in between. The level of maintenance is assumed variable and opportunities for it to be damaged or settings altered considerable.

In many cases, farmers want to operate at a certain bout width. That may be set by spray tramlines or some other interval determined by preceding operations. The issue then is firstly determining if performance at that bout spacing is acceptable, and if not, what to change to make it so.

Different fertilisers have different physical characteristics, which affect spread distribution patterns. Adding to this are factors such as different batches, delivery impacts and multiple handlings and absorption of atmospheric water.

How relevant is a test of tuned equipment applying urea to a field application by occasionally used equipment of SOA on a damp or windy day?

A farm can have several operators use the same machinery to apply many different products, each requiring separate calibration for correct rates and placement. The purpose of this project is to determine a protocol that will provide a satisfactory level of surety that farm application equipment is calibrated and fertiliser placement is acceptable without the need for Spreadmark certified application equipment or for farm staff to undergo full Spreadmark training. It is noted that in early 2015, there have been proposals to create a version of Spreadmark for farm equipment.

A Proposed Protocol for NZ Farmers

A calibration check includes assessment of both application rate (kg/ha) and uniformity (CV). Farmers indicate determining the rate is reasonably easy and commonly done. The veracity of that assertion has not been rigorously tested. Casual observation suggests many use a nominal paddock area and approximate total fertiliser spread. Some do a quick rate check after the first hectare or so, possibly estimating how much has gone from the bin.

Rate can be checked in three ways:

- Total weight spread by area covered
- Weight collected in a time period by spreader speed and effective swath width
- Samples collected from trays spaced across a transect, either physically or theoretically over-lapped.

Very few farmers complete any formal uniformity assessment. They do mention "having a look at spread".

Uniformity requires collection of samples from a spreading event and calculation of a uniformity value, typically coefficient of variation. It will involve either physical or theoretical over-lapping of adjacent swaths.

Two options considered for the on-farm protocol were:

- a set number of collectors per swath (collector spacing changes with swath width) or
- a set spacing between containers (collector number varies with swath width).

Early tests trialled a 24 tray transect. This compares most closely with the ASAE protocol of 10 trays per swath though uses 2.4 times the number of trays. With this system, a narrow throw machine could have trays overlapping each other while a wider throw machine will have trays progressively further apart (Figure 2).

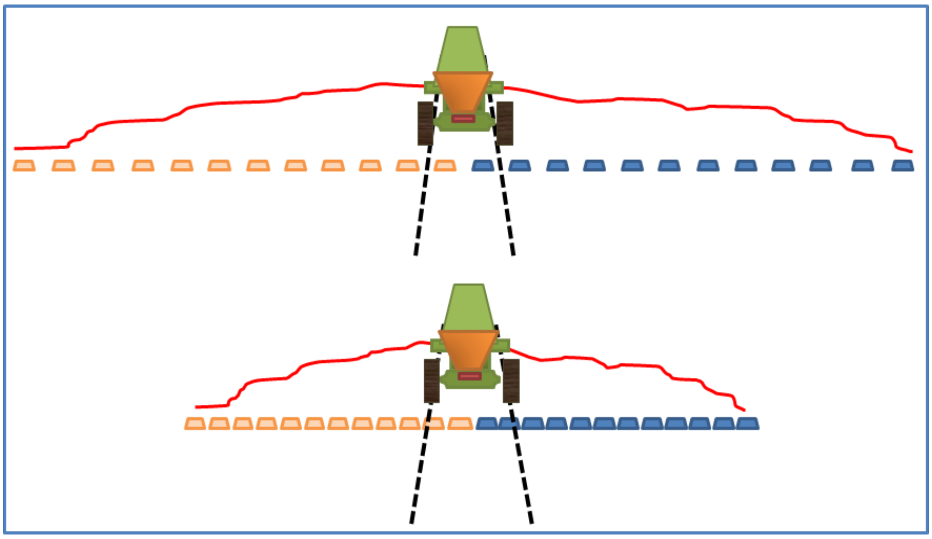

Figure 2: Alternative layout 1: Equal number of collectors under swath width

An alternative layout, closer to the other international standards, is to have trays at a set spacing (Figure 3). A wider throw machine requires more trays, but the "trays per hectare" is the same.

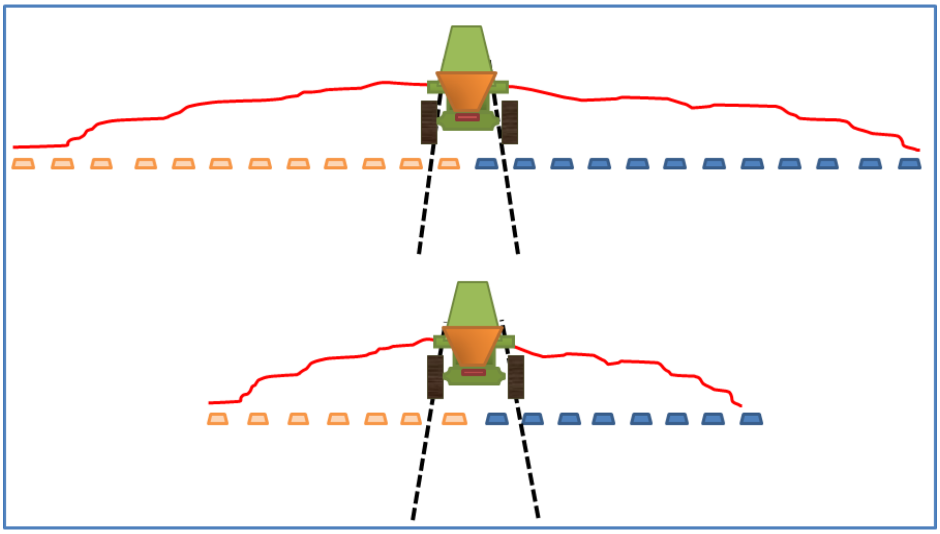

Figure 3: Alternative layout 2: Equal spacing between collectors under swath width

Following feedback from the Project Team, a small poll of farmers and other stakeholders asked how long a calibration check should take, and what and how many trays should be used.

The majority of those polled chose Layout 2 (Figure 3), the set collector spacing, rather than a set number of collectors. It was felt that 1m was close enough, and that a larger spread machine justified extra assessment time as it was probably covering more ground so the potential impacts were greater.

General opinion was to use standard test trays if possible, especially given the need for baffling to stop fertiliser loss from bouncing out. In limited checks we found about 30% of the fertiliser was not being caught in a readily available plastic tray compared with the standard baffled tray.

A larger tray is recommended as weighing samples is complicated by the very small quantities involved – often a single prill in the outer containers. Scales weighing to 0.01g are required, but satisfactory options are readily available at reasonable price. Most people suggest using standard test trays, given the need for baffling to stop fertiliser bouncing out.

The question was also put to delegates at the 2015 Fertiliser and Lime Conference. Feedback following that indicated no strict rules should be needed, but rather testers (farmers) are made aware of the critical factors influencing distribution and its measurement.

The MPI SFF project includes testing a range of machines on farm. Test spread-pattern and application rate checks performed to date show there is a need for wider testing by farmers. Unacceptable CVs and incorrect application rates are the norm. The reasons for poor performance vary but are usually easily corrected. Information dissemination is essential.

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