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Arable Update

Maize: Issue 93

Making the most of long-term cropping data: Evaluation of reduced tillage maize trial data

Background

Between 2005 and 2020 FAR conducted 38 trials investigating tillage establishment methods for maize production. Most were analysed at the individual site/trial level.

This Maize Update, discusses insights gained from aggregating all of this trial data. It includes information on the effects of crop establishment methods on established plant populations, maize yields and, where available, associated gross margins. Further topics of interest included relationships between nitrogen application rate, seeding rate and planting date on crop establishment outcomes.

All data included in this analysis were provided to Plant & Food Research (PFR) by FAR. A description of the data provided is included as Appendix 1.

Key points

- On average, full cultivation produced more yield than no-till or strip-till.
- No-till tended to have higher gross margins (based on a farm gate price) than strip-till or full cultivation.
- On average, established population was lower for no-till than full cultivation or strip-till.

General description

Thirty-eight trials were conducted at 15 sites in 5 different regions of New Zealand: North Head, Hamilton, Bay of Plenty, Gisborne and Hawke's Bay. Twenty-nine of these involved grain and 9 involved silage. Full cultivation (FC), strip-till (ST) and no-till (NT) were examined. FC was part of the investigation on 36 trials, ST on 26 and NT on 32. Eight different seeding rates (expressed as 1000s/ha) were also examined: 76, 88, 89, 90, 100, 105, 108 and 120.

Statistical analysis

As the data investigated did not come from a single controlled experiment, there could be many unreported influences on the outcomes (for example, trials spanned 15 years, but climate was not considered within the analysis as a variable/factor, neither were soil quality or soil structure etc.).

Results and discussion

Yield

There was no clear evidence of a yield trend over the date range studied; yields were not consistently increasing or decreasing with consecutive harvest year.

Tillage

Tillage treatment did not appear to alter the general range of yields observed, which were approximately 6–15 t/ha for grain and approximately 15–27 t/ha for silage systems irrespective of tillage treatment. When yield was standardised within each trial (to remove the effect of potential yield differences caused by, for instance, soil type), a small yield advantage to using full cultivation establishment practices emerged. Median (the value in the middle of the data) grain yield was approximately 5% higher for FC compared to the NT treatment, and 25% of the trials had a greater than 10% yield advantage. In real terms, the 5% yield advantage equated to 0.5 t/ha more grain harvested from FC than NT treatments (noting that it is not known whether the NT was best practice or not).

No conclusions could be drawn on the effect of tillage on silage yields.

Seeding rate

Higher seeding rates typically resulted in higher plant populations for both the grain and silage trials (R^2 = 0.70 and 0.85, respectively).

Examination of a subset of data (8 trials and 5 sites) from seeding rates of 88,000–90,000 seeds/ha showed that established plant population was consistently lower for NT compared with ST and FC, though the range of populations appeared similar (e.g. 72–97 for NT and 78–106 for FC).

Gross margin

Data were not available for all trials, but analysis tended to show an economic advantage to NT over FC. Although there appeared to be a small yield advantage to FC, when the cost of additional cultivation passes (treatments for one and two passes were combined) was included, there appeared to be an economic advantage in NT. (Note, however, that there is an opportunity cost not factored in – the farmer might need to purchase an extra half tonne of feed for feeding animals.).

Summary

The main findings from the mini meta-analysis were:

- An apparent yield advantage in grain of approximately 0.5 t/ha to using FC establishment practices was noted.
- Established plant population was not more variable under NT than FC but was lower overall.
- When a subset of the data was used to include only sites with a seeding rate of 88,000 to 90,000 seeds/ha, the established plant population was consistently lower for the NT tillage (median 85,000 seeds/ha) than ST and FC treatments (medians 90,000 and 88,000 seeds/ha).
- The lower established plant population for NT might have contributed to the slightly lower yield trend.
- When the cost of additional cultivation passes was taken into account, the economic advantage tended to favour NT rather than FC.
- Potential insights were restricted by the limited data sets in some areas.

References

Jenkins, H, Lawrence-Smith, E, and Fraser, P (2021). Evaluation of reduced tillage maize trial data supplied by FAR. A Plant & Food Research report prepared for: FAR. Contract No. NA. Milestone No. 87687. Job code: P/443074/01. PFR SPTS No. 21567. 27p.

Appendix 1.

The raw datasets were compiled by Allister Holmes (while he was at FAR). The following points are important to note:

- There were 386 rows or observations in the main sheet of data.
- The data came from 38 trials at 15 sites in five regions of New Zealand.
- The trials took place between 2005 and 2020.
- The trials mostly involved replication. However, for the purposes of this meta-analysis, some of the data have some pseudo-replication that needed to be taken into consideration.
- For each observation, PFR was provided with Harvest.year, Region, Site, Treatment, FAR.Code and Grain.yield or Silage.yield (depending on the type of trial).
- There were missing GPS coordinates for three sites and missing soil type for three sites.
- The maize hybrid, seeding rate, established plant population and amount of N applied data were all somewhat limited due to missing data.
- There were data giving the specific full cultivation method. No trial used more than one full cultivation method.
- In addition to grain yield, we have incomplete moisture percentage and test weight data.
- Incomplete data for dry matter (DM%) percentage were provided for silage yield.
- An additional sheet was supplied that showed financial information, but the extent of what has been included to derive this information was not clear or defined.

Acknowledgements and further information

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