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# Statistical analysis for the Pasture Variety Trial Network

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## **Executive Summary**

The Statistical Analysis for the Pasture Variety Trial Network (PVTN) is a project that delivers data management, statistical design and analysis services to the PVTN. The project has delivered an Excel template for trial service providers to use when collecting trial data. The template ensures that data is recorded in a consistent manner over trials and can be used to transfer data from Excel files into a database. A further template has been developed for the reporting of results so they can be more readily made available through the web tool developed by MLA for the dissemination of seasonal variety performance estimates.

The project has delivered a novel statistical method for estimating seasonal variety performance and a novel method for reporting results using a 5-star rating system. This technology is described more fully in the document "Statistical analysis of single site, multi-harvest biomass data" which is attached to this report.

Red meat producers benefit from this project as it delivers high quality seasonal variety performance information which enables producers to make a more informed decision in regards to selecting a suitable pasture variety for their environment.

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## 1 Background

This project is part of the Plant Breeding and Evaluation pillar of MLA's Feedbase Investment Plan (FIP). When MLA requested tenders for this project the terms of reference identified the following benefits to the red meat industry of establishing an independent pasture species field trial program;

- Increasing producer and advisor confidence in the performance of pasture varieties through an independent endorsement of data quality
- Demonstrating of the value of high performance plant genetics to assist producers to meet their goals
- Enabling accelerated adoption and use of high performance pasture varieties as a result of independent information to support economic decisions to renew existing pastures
- Developing a 'common language' of pasture value for producers and supply chain participants
- The introduction of a 'pasture for purpose' mantra amongst livestock producers, their advisors and supply chain participants

The PVTN includes trials involving the following pasture species

- perennial ryegrass
- annual and italian ryegrass
- phalaris
- tall fescue
- cocksfoot
- sub-clover
- lucerne

Perennial pasture trials are conducted over a period of 3 years and annual trials over a period of 12-15 months. In both cases there are a number of harvests (or cuts) over the period of the trial and the trait measured and statistically analysed is biomass (kg/ha) on a dry matter basis. Trials are conducted according to a documented protocol and all aspects of the PVTN including this project are overseen by a PVTN Technical Advisory Committee.

### 2 **Project Objectives**

The objectives of this project, as stated in the research agreement, are;

- 1. Configured the Katmandoo database for the management of PVTN trial data
- 2. Imported existing data into the database
- 3. Developed analysis protocols for PVTN data
- 4. Performed at least three analyses of PVTN data
- 5. Provided reports to industry based on PVTN data analysis
- 6. Provided advice to PVTN trial operators about trial design and analysis

### 3 Methodology

All trials are randomised complete block designs with 4 replicate blocks. The statistical analysis of the data arising from these trials is described in the technical document "Statistical analysis of single site, multi-harvest biomass data" which is attached to this report. This technical document outlines a novel approach for estimating seasonal variety performance. The motivation for the development of a new approach for estimating seasonal variety performance is that the standard industry practice of defining seasons using calendar dates and estimating daily biomass production by dividing up on a pro-rata basis the biomass harvested at a particular time is less than optimal. The pro-rata approach is less than optimal for two reasons; firstly, it assumes that biomass production is constant over the period between harvests and secondly, the approach precludes the ability to model spatial variability in the field. The latter being important in the majority of harvests in all trials.

The attached technical document also outlines a new approach to reporting seasonal variety performance using a 5-star rating system. The decision to use a 5-star rating system was made by MLA after conducting a focus group on how best to deliver the results of the PVTN to red meat producers.

### 4 Results

The results of the statistical analysis for each trial are provided in a purpose built Excel template which is then used to upload results into a database accessible by the web tool developed by MLA for information dissemination to red meat producers. An example of the structure of the Excel template is provided in the attached technical document. The main feature is that the template has column headings "Trial", "Species", "Variety", "Predicted Mean", "Standard Error" and for each season there are 6 columns which contain the probabilities of a variety belonging to a specific 5-star rating (1 column per rating) and the 6<sup>th</sup> column indicates the most likely rating, i.e., the rating with the highest probability.

# 5 Discussion

This project should be viewed as an important initial step towards setting up an independent pasture species field trial program. A great deal of work has gone into developing trial protocols and developing templates so that data is collected in a consistent manner. New statistical methods have been developed for the estimating seasonal variety performance. The attached technical document discusses how these new methods can be further improved and the statistical challenges associated with the 5-star rating system.

A discussion on each of the projects objectives follows.

#### 1. Configured the Katmandoo database for the management of PVTN trial data

The most important part of data management has been the development of a template for trial service providers to use so that data is collected in a consistent manner over all PVTN trials. That data is then uploaded into the Katmandoo database and then exported into an

Excel file ready for data analysis. This Excel file could be imported into any database, i.e., the Katmandoo database is not the only database that could be used if a decision was made to use another database package.

#### 2. Imported existing data into the database

All independent trial data is in a format which can be imported into a database such as Katmandoo.

#### 3. Developed analysis protocols for PVTN data

A new method for estimating seasonal variety performance and for delivering results using a 5-star rating system has been developed. This is discussed in the attached technical document.

#### 4. Performed at least three analyses of PVTN data

All the data from the independent trials at Wangaratta, Casterton, Blayney, Cressy and Bairnsdale have been analysed. The trial at Stockinbingal was delayed by a year and the complete data for that trial was yet to be made available at the time of writing. There were a number of registered trials, however only one has been analysed and that was the trial at Howlong which was used as the case study in the attached technical document. The technical committee made a decision to focus on the independent trials as there were unresolved issues with a number of registered trials; the main issue being the method for measuring biomass on a dry matter basis.

#### 5. Provided reports to industry based on PVTN data analysis

The attached technical document outlines the statistical approach to estimating seasonal variety performance and reporting results using a 5-star rating system. It is intended that this document will form the basis of a journal article which when published will provide the industry with a publicly accessible description of the PVTN data analysis.

#### 6. Provided advice to PVTN trial operators about trial design and analysis

Advice to PVTN trial operators has been in the form of providing statistical designs and advice on practical issues such as using the Excel template and the use of "fillers" in cases where there is insufficient seed.

### 6 Conclusions/Recommendations

MLA's investment in the PVTN should be viewed from the perspective of what an independent pasture species trial program will be delivering to red meat producers in 5-10 years time. The initial costs in starting an independent pasture species trial program have been significant in terms of time, money and effort. The PVTN has provided a solid foundation upon which to build. Those foundations comprise a well documented protocol, an active industry focussed technical committee, an experienced group of trial service providers

and a consistent approach to data management, data analysis and reporting. Our recommendation is that maximum benefit of an independent pasture species trial program to red meat producers will only be realised if there is a consistent long-term investment in the program where part of that investment is directed at data management, statistical design and analysis and reporting. The grains industry "National Variety Trials (NVT)" program is an Australian example of this type of long-term investment.

# 7 Key Messages

The key messages to red meat producers is that this project provides independent information to producers on seasonal variety performance which they can use when making the important decision of which variety to use in their production system.

# 8 Bibliography

A comprehensive bibliography is provided in the attached technical document.

# 9 Appendix

#### 9.1 Project budget

This project was under budget with a saving of \$16,350 (ex GST).