PROJECT TITLE: **IMPROVED ACCESS TO TRUST FUNDED TECHNICAL REPORTS: SITUATIONAL ANALYSIS FOR ON-LINE PUBLISHING OF ABSTRACTS AND REPORTS FOR VISIBILITY BY SEARCH ENGINES**

FINAL REPORT

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1. PROJECT OBJECTIVES

A situational analysis and pilot study were undertaken to test the feasibility to publish one-page abstracts of Maize Trust technical reports online with registered unique DOI (Digital Object Identifier) or URI (Uniform Resource Locator) numbers, making the reports visible by popular scientific search engines such as Google Scholar or Crossref. Ten Maize Trust technical reports and a Ph.D Thesis were used for the test case study to investigate the feasibility of having the SAGL managing the repository for the Trusts. The practical aspects relating to the writing and editing of abstracts or research bulletins to summarise long reports were evaluated. The visibility options of abstracts and reports were investigated for two potential repository choices. Adjacent to that activity, the feasibility of storing the full reports in repositories alongside the abstracts and linked to existing Libraries for safekeeping were studied.

2. WORK METHODS

2.1 WORK FOCUS

The use of repositories and their links to search engines such as Google Scholar were investigated first. In order to produce documents that can be indexed with unique electronic identifiers on search engines, these documents need to conform to certain specifications related to the repository of choice. These specifications are typically based on the ISO numbering systems (ISO 26324 for DOI numbers and ISO/IEC 18975:2024 for URIs). The search engines also have specific criteria for documents to be indexed and searchable. It was found that managing and registering a stand-alone repository will be too complex and expensive to manage because of the numbering requirements. The risk of having a stand-alone repository also links to available future funding, and unforeseen realities may render the repository inoperable if it is not tied to a significant support structure from a large repository system such as those based at Universities or International research groups that can continue to exist

independently in case of future structural or funding changes at the SAGL or the Trusts. Therefore, alternative options were investigated, such as Open Source scientific repositories linked to large Universities or research institutions. After consideration of practical implementation challenges, two repositories were selected for further investigation. Both Repositories are based on Open Source software and offer the convenience of direct managing. The selected repositories that were investigated are the DSpace system operated by the University of Pretoria Merensky Library, which can link all documents to Google Scholar and the DOI system, and the Zenodo repository which only links documents to the DOI system, but offers less restrictions on the document formats for example the uploading of interim or incomplete documents and raw datasets.

It will not be cost effective to operate both Repositories and further discussions with the University of Pretoria will be initiated to find a solution for scanning and archiving of incomplete reports or reports not fitting into the "scholarly" definition of Google Scholar. Examples are financial auditing reports or farmer development reports. It is possible to place restrictions to access to full reports with both Repositories, and the recommendation is that where applicable, only an abstract of a report is made visible on Google Scholar while the full report, although scanned and stored in the repository, remains restricted. Such detail can be investigated further in a follow-up project.

It is very important to take note that the two commonly used digital numbering systems namely the DOI and the URI systems, are two separate systems that do not automatically refer to each other. Therefore, if a document only has a URI number, it can be seen on Google Scholar but not on other search engines such as Crossref. A similar situation is true for DOI numbers, a document with only a DOI number cannot be indexed on Google Scholar. Most recent practices focus on allocating both numbers (DOI and URI) to documents for maximum visibility, which should be done by the repository.

Ten project reports (Final versions) were randomly selected from the Maize Trust archives and evaluated for suitability for inclusion in the repositories. Additional aspects such as the need for POPIA compliance and IP protection were also investigated. Although the original idea in the project workplan was to upload one or more of these reports onto a repository as an example, the issues around POPIA protection of authors' identities have not been adequately addressed and will need a wider industry consultation to make a final decision. Therefore, to illustrate how a document is uploaded and visible on Google Scholar via the University of Pretoria library DSpace system, the Ph.D thesis of Dr Corinda Erasmus which was done in 2003 as part of a Maize Trust funded research project was used as example. The Thesis is protected under the IP structure of the University of Pretoria and visible on Google Scholar.

Originally, it was also intended to make use of outsourced publishing services to write and edit summary bulletins and abstracts, but the costs were found to be prohibitive and impractical and the process was then completed in-house with existing SAGL expertise instead.

2.2 RATIONALE FOR THE PROJECT

Each Trust (including the Maize Trust) has a database of technical reports of Trust funded research work done for the past 20(+) years. These databases are not currently visible to the broader scientific community because these reports are not visible on the commonly used scientific search engines such as Google Scholar. Although the reports are in the public domain, being published on the Trust websites (and on the SAGL website), the reports are not detectable by search engines because they do not have unique identifier numbers (DOI or URI).

As a result, students and researchers are often uninformed about the excellent work done and funded by the Trusts and unless a scientific publication in an international scientific journal was written as part of the project, the research remains hidden. The only other way that researchers become aware of a particular project is if the researcher happens to know someone who has done work for the Trusts. Many research projects are industry-specific, meaning that a publication in a peer-reviewed Journal is not always practical or possible, yet the work is contributing to the scientific body of knowledge and often involves research on large numbers of samples providing a unique understanding of issues such as crop quality, processing properties or agronomy.

Excellent knowledge is therefore lost to the broader scientific community because of the unintended invisibility. Newly planned research work becomes inefficient if new researchers duplicate work already done in the past using Trust funds. Scientists and researchers also do not get proper recognition for their work when compared to publishing of a book chapter or other means.

The Primary objective of this situation study was therefore to find a cost-effective way of adding technical reports to active and long-living repositories linked to popular search engines.

3. RESULTS

3.1 GENERAL BACKGROUND, DEFINITIONS AND SELECTION OF PROJECT REPORT EXAMPLES

Research was first conducted to understand how existing research repositories currently work, and how documents are indexed to become visible on search engines on the Internet. This report first describes the definitions and terminology related to the field of repositories, followed by investigating of the practical aspects of placing documents on two selected repositories. The repository at the University of Pretoria Library was identified as the most suitable option for further implementation, and meetings were held with them to discuss future collaboration. The feedback from those meetings is included in this report (section 3.3).

The list of ten Maize Trust Report is shown in section 6.1 along with suitability classifications. Examples of a research bulletin and an abstract summarising research reports are provided in Appendixes A and B. Terminology is defined in sections 3.1.1 – 3.1.5

3.1.1 What is a repository?

A library repository is a digital platform established by academic or research institutions. Its primary objective is to collect, manage, preserve and disseminate the intellectual and scholarly outputs of an institution or a consortium of institutions and allied companies. This may include amongst others:

- Research papers and technical reports
- Theses and Dissertations
- Conference proceedings
- Teaching materials
- Administrative documents.

Two types of repositories exist namely 1) Institutional repositories focussing only on work generated inside the institution and 2) Open Access Repositories which includes work from any qualifying entity, allowing open and free access to relevant content.

3.1.2 Who has access?

Repositories can be open access or restricted access repositories. For restricted access, various methods such as password protection can be used. Access is often ringfenced to include specific scientific communities, who can register via the library or institution hosting the repository.

3.1.3 How can reports or publications be made visible on search engines?

Various search engines to find published scientific documents and reports exist such as Google Scholar and Crossref amongst others. Focussed search engines such as PubMed or Science Direct operate in specific fields while Google Scholar includes all science fields. Google Scholar is the most well-known and the largest engine widely used by Universities. It will find documents that have been assigned a URI number (handle type) as the primary identifier.

Crossref, another search engine, operates by finding DOI or ORCID iD (author registration) numbers. It is not directly linked to Google Scholar and it does not use the URI handle system. Crossref is a consortium of around 3000 publishers while Google Scholar is a free opensource search engine linked to Google. Google Scholar, with 389 million records, is currently the most comprehensive academic search engine available to everybody.

For a document to appear on Google Scholar, it must be properly indexed by the repository or publishing entity. Google Scholar automatically indexes content, but it has specific criteria for inclusion. These criteria must be configured correctly by following Google Scholar's indexing guidelines, which include having full-text content accessible in HTML or PDF format and providing metadata such as the title, authors, and publication details. If the repository doesn't meet these criteria, Google Scholar might skip indexing it. Due to the specific nature of the indexing requirements, it is not recommended to develop a stand-alone indexing activity because it is too time consuming. The institution must also register with Google Scholar and it entails paying subscription fees. It is more practical to link up to an existing system being managed by a large library responsible for managing repositories for scientific content.

If the document is in the correct format and indexed through a legitimate repository, it is also possible to manually request indexing for visibility on Google Scholar by visiting https://scholar.google.com/scholar_contact.html and filling out the form with details about your document. This process is usually not necessary if a library repository does the indexing.

3.1.4 Difference between an archive and a repository

Although the two terms are often used interchangeably, the archive is specific for historical documents while a repository can include any documents, such as interactive documents as well as archival documents. The term repository is more used for digital systems while archives can often still be referring to hard copy documents.

3.1.5 DOI vs URI number systems

All documents stored on electronic repositories are assigned a unique number to identify them which can either be a DOI or URI number. The URI system is the older system while the DOI system was implemented more recently to implement global uniformity within the ISO (International Standards Organisation) standards system for non-academic electronic documents as well.

The DOI (Digital Object Identifier) is a unique alphanumeric string that identifies content and provides a persistent link to its location on the internet. DOIs are created and standardized by the International DOI Foundation (IDF) and are typically found on the first page of the digital article. They are static and do not change, making them easy to locate even after the source has been moved. The DOI system was developed to conform to ISO standards. It is also a handle system like the URI system, but it does not change even if the location of the repository changes. It is, however, vulnerable to becoming a dormant or "dead" identifier if not maintained by the publisher or repository. Therefore, many repositories ask a handling fee for

each DOI number that must be paid yearly. I can become cumbersome and expensive to maintain.

In contrast, a URI (Uniform Resource Locator) is a standard web address that specifies the location of digital information on the internet. URIs can change if the website is edited or updated, or if the source is moved. Many online databases assign sources with so-called "stable URIs", sometimes called "permalinks," which will not change and link directly to the source on that specific webpage. A URI (Uniform Resource Identifier) is also known as the "handle system" and is a unique sequence of characters that identifies an abstract or physical resource. There are two main types of URIs: URLs (Uniform Resource Locators), which provide a location for a resource, and URNs (Uniform Resource Names), which provide a unique name without a location. URIs are also vulnerable to becoming dormant if the fileserver links become obsolete. That is why the selection of a large stable repository is very important, to ensure that links remain accessible. However, maintenance is focussed on the fileservers, and no fees are applicable for renewing URI numbers.

When citing digital content, writers can then use DOIs or URLs. For works from databases that publish original, proprietary material available only in that database, include the name of the database or archive and the URL of the work. The safest option for ensuring long term document electronic visibility is to have both a URI and DOI number assigned.

3.2. REPOSITORY TYPES:

3.2.1 Open source

DSpace is an opensource software platform designed for the digital preservation and distribution of digital materials. It allows users to create and manage digital repositories, facilitating the collection, preservation and access to various types of digital content. DSpace is supported by a collaborative community of users and developers.

With DSpace version 4.0, it is possible to assign DOIs in parallel to the URU Handle system. Documents can thus be assigned both identifiers. Therefore, DSpace can automatically generate, reserve and register DOIs for every item that enters the repository, but still relies primarily on the Handle assignment system for their URLs. The University of Pretoria Library makes use of the DSpace system.

3.2.2 Funded systems

Funded repositories are more specifically geared towards specific multi-year research programmes such as the European Framework programmes. One example is the Zenodo EU Open Research Repository based in Switzerland. Zenodo is general-purpose repository that

hosts mixed resource types (articles, data, software, posters, presentations, interim reports etc). Zenodo allows users to edit and change the documents after publishing, and new DOI numbers are generated for each version. The allocation of URI numbers cannot accommodate this because URIs are assigned only to final publications that cannot be changed. Because Google Scholar specifically focuses on unalterable documents, it cannot index documents placed in the Zenodo repository. Zenodo therefore only uses the DOI numbering system for citing documents and it can be searched on alternative search engines such as CrossRef. Unfortunately, these documents will then not be visible on Google Scholar indexing system.

The Zenodo repository system is based in Europe, any DOI numbers will have to be purchased at a fee, and updated yearly, resulting in a regular running cost. Although the Zenodo repository started initially as a repository specifically for European Union Framework projects, it has become open to any research group or platform in the world interested in a safe storage and archiving space for large quantities of documents. Zenodo is housed at the CERN laboratories near Geneva in Switzerland, and is an intergovernmental scientific organisation dedicated to particle physics. It has access to very large computing infrastructure due to the processing requirements of the Hadron particle collider. The repository is a spin-off project to utilise excess computer space and focuses on the management of very large databases. However, the viability of CERN is dependent on funding streams from many countries, which can make it vulnerable to changing geopolitics.

3.2.3 Fundamental difference between the University of Pretoria DSpace (UPDspace) and Zenodo

The major difference between the two repositories is that Zenodo allows changes to documents after it has already been uploaded while Google Scholar does not allow any changes. However, because Zenodo allows changes, it cannot allocate URI numbers to documents and therefore it cannot index documents on Google Scholar.

Zenodo is based in Switzerland while UPDspace is based in Pretoria. From a logistics perspective it is preferable to work with a repository close to home because access is much easier for solving any possible problems related to software etc.

3.3 University of Pretoria Repository (UPDspace)

3.3.1 Meetings with UPDspace on 23 September and 28 October 2025 (Mr Tlou Mathiba, UP Library services)

Discussions were held with the University of Pretoria Library services at the Merensky Library on the Hatfield Campus to evaluate possibilities for adding Trust reports to the UPDspace repository. Dr Erasmus first visited Mr. Mathiba on 23 September 2025 to introduce the

project idea and both Dr. Erasmus and Ms Wiana Louw then visited Mr. Mathiba on 28 October2025 for a more detailed discussion of possibilities and logistics.

3.3.2 Summary of outcomes of the meetings:

The use of the UPDspace repository is available for any outside entity such as the SAGL or any of the Trusts, as an extension of repository services on the OpenSource platform of the library of the University of Pretoria. A contract agreement can be discussed.

Use of the repository service is free of charge providing that the entity wishing to use the platform maintains its own system. The University of Pretoria will upload the UPDspace software free of charge onto the SAGL's system and train operators on how to scan, upload and manage documents. The University of Pretoria can also assist with bulk scanning and uploading services for which a quotation can be provided. The SAGL will have to appoint someone who can maintain the system, preferably utilising Information Science interns who need experience. A budget to cover the costs of a senior scientist who is qualified and able to summarise and categorise reports and who will work with the intern must be provided for via the Trusts funding systems.

Any type of documents can be uploaded including technical reports, research notes, research papers, theses, dissertations or technical bulletins. It can also include survey reports such as the various crop quality surveys, including archived ones.

The UPDspace repository has the option of restricting access to certain parts of documents if needed. Although the UPDspace operates on Open Source principles, it also operates under current POPIA regulations and respects access restrictions where applicable. In the case of research reports from Trusts, it is the best policy to write a technical bulletin or abstract for direct access, but with a link embedded where access to the full document can be obtained via various options. For example, a link to an email address or a login system based either at the University of Pretoria or the SAGL can be constructed. Full reports can still be uploaded onto the UPDspace system for safekeeping. However, as the objective of the use of the repository system also includes increased visibility of valuable research being funded by the Trusts, it is advisable to also pre-screen project reports and focus on those ones that can be made accessible to the wider research community.

All documents on UPDspace are visible internationally on both the international library search engines and on Google Scholar. After upload and URI number assignment is completed, the document can be seen on Google Scholar within one month. DOI numbers are also assigned for wider search engine exposure.

Possible costs for using the University of Pretoria DSpace system will be related to the actual scanning of the documents (for example appointing a research intern), or the possible purchase of an extra fileserver if the volume of documents become too large to be linked to

the University's existing available space, which can be discussed in detail once the decision has been made to proceed with the project.

Searches for specific documents can be done either via the internal UP library search engines or via Google Scholar. Figure 1 shows the search results for the thesis "Maize kernel translucency measurement by Image Analysis and its relationship to vitreousness and dry milling performance" via the Library search engine. Browsing can also be done via author (see Figure 2 for Author "C Erasmus"). The assigned URI handle for the thesis is shown in Figure 3. This allows visibility on Google Scholar as seen on Figure 4.

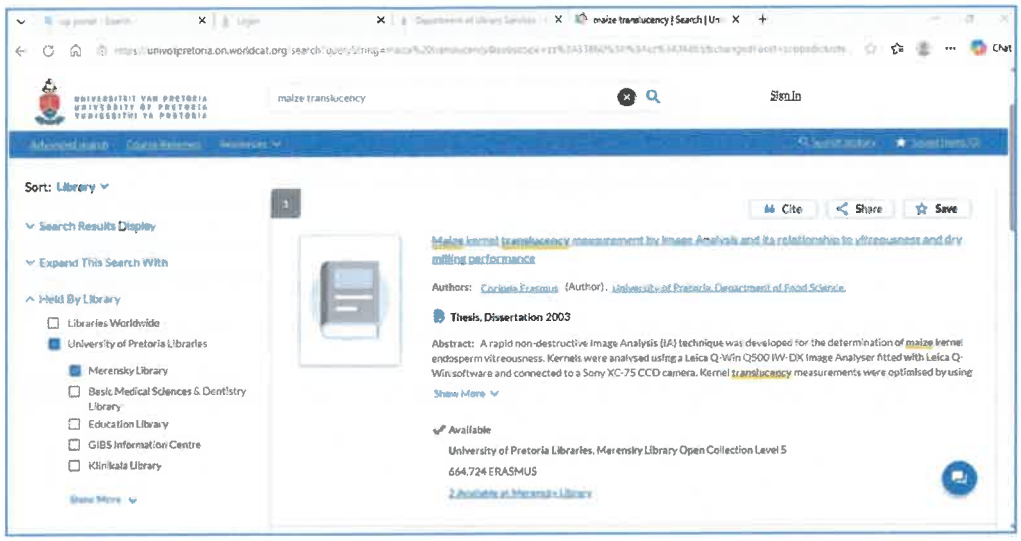

Figure 1 Search Results on the UPDspace for a PhD Thesis (old Maize Trust funded document).

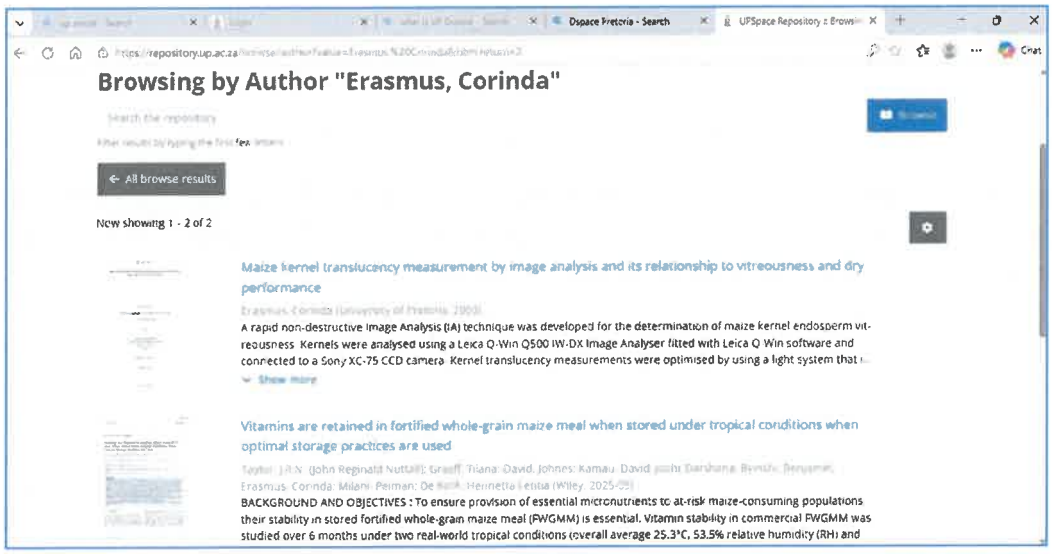

Figure 2 Examples of two documents (thesis and research paper) by Author " C. Erasmus" on the UPDspace search engine.

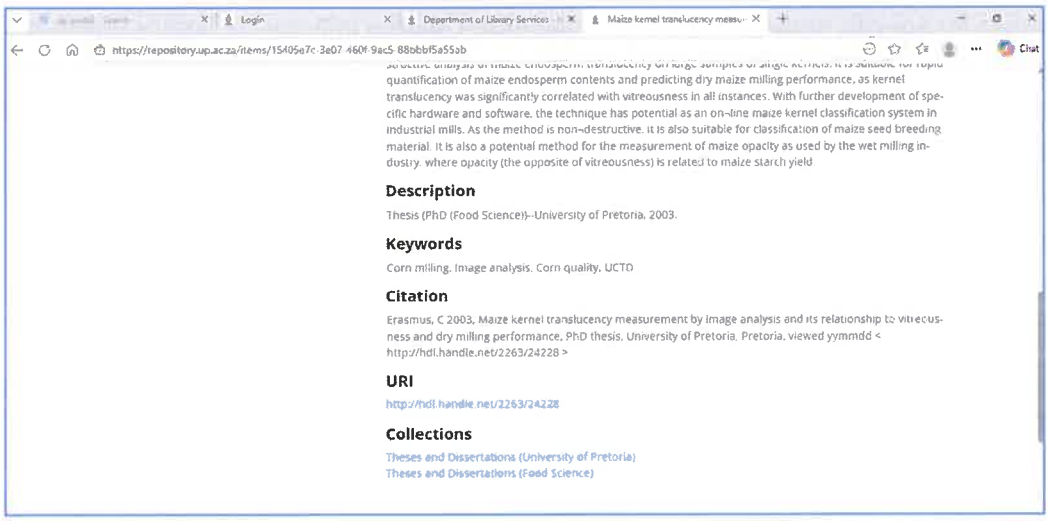

Figure3 URI handle for the thesis "Maize kernel translucency measurement by Image Analysis and its relationship to vitreousness and dry milling performance"

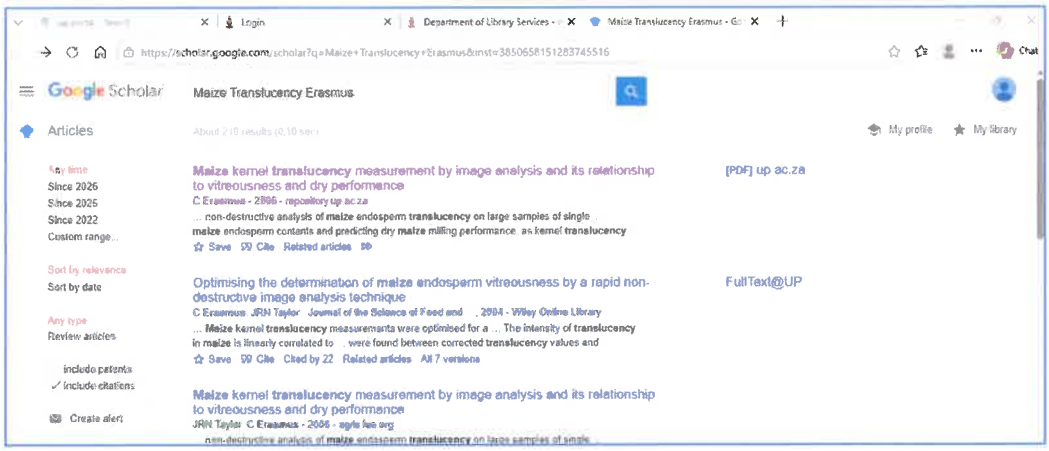

Figure 4 Google Scholar visibility for the thesis "Maize kernel translucency measurement by Image Analysis and its relationship to vitreousness and dry milling performance" via the UPDspace repository.

It is important to note that if the UP repository is used, all documents will also show as linked to the University of Pretoria fileserver ([PDF] up.ac.za) indicated as "repository up ac za" as seen in Figure 4. The University gets free visibility exposure on the internet via this route which offsets the free use of the facilities. The specific Trust wishing to make use of this repository system will have to add their affiliation to the report title to distinguish it from the academic system. This can be done as part of the abstract summaries and will be discussed with UPDspace. If a project was done in collaboration with another University, an agreement

will have to be drawn up with the University of Pretoria on how to ensure that the report authorship is not unintentionally misrepresented on Google Scholar. This matter still needs some clarification.

3.4 EU Open Research Repository (Zenodo)

To evaluate the possibility of using the Zenodo repository as a back-up or alternative to the UPDspace repository, the SAGL registered on the Zenodo system as a research entity.

3.4.1 Registration on Zenodo

Researchers and publishers who are registered on the ORCID registration system for published scientific papers and books can register as single users on the system. Zenodo also accepts research institutions and laboratories or non-profit companies active in the publication and distribution of reports with scientific results such as the Crop Quality reports. Dr. Corinda Erasmus is registered on ORCID and she tested the system by creating her own account. It was also possible to register an account for the SAGL as a publisher of reports with scientific content. At this stage, no documents have been uploaded because of the need to decide on issues such as the visibility of documents and the requirements for the POPIA act and also whether the Zenodo system is a feasible option for the Trust reports. However, the SAGL account is active and accessible (although empty) via the following passwords:

Zenodo username: SAGL

Zenodo password: Granesade145#

The account confirmation page for Dr. Erasmus is shown in Figure 5. The Zenodo account is also linked to the SAGL admin email address admin@sagl.co.za. Due to uncertainties around the implications of the POPIA act related to author visibilities, no further actions were taken to upload any reports on Zenodo.

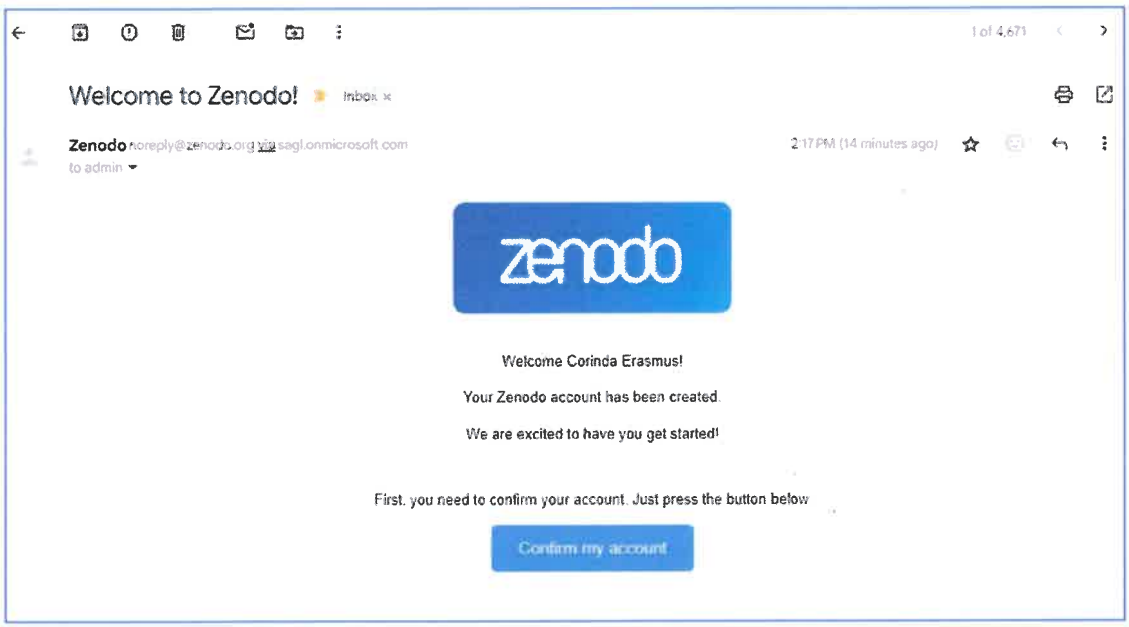

Figure 5

4. POPIA CONSIDERATIONS

4.1 New reports

Once the decision has been made to archive all future Trust reports, the decision will have to be communicated to all stakeholders, for example through the regular Forum meetings. New Reports will have to include a section where authors must indicate willingness that their names can be loaded onto the repository system for visibility on Google Scholar. The sensitivity of research information must also be indicated, to determine access restriction levels on any opensource system. At this stage, no formal decision-making protocol has been discussed with anybody, it will have to be taken up once the decision has been made to utilise the repository systems in future.

4.2 Archived reports

The issue of author permission for archived reports needs to be discussed. Many authors of the older reports are not in a research position anymore to give permission for the information to be placed on an opensource platform, having either retired or being unavailable due to other reasons. Although the Intellectual Property of the research projects is vested in the Trusts, author's names will still be visible on the search engines such as Google Scholar. Before any large-scale uploads of especially archived documents can be undertaken, discussions are required to address the issue of author visibility. Many authors will welcome the visibility because it enhances scientific career history and promotes a scientific CV, but there is also the

issue of research work of a sensitive nature as well as projects that may not have been successful, for which authors may prefer restricted access. Once the University of Pretoria has installed the UPDspace software, the various options for access restrictions will be discussed and implemented. In the case of the Zenodo repository, all decisions in terms of accessibility will have to be managed from the SAGL or Trusts, and it is more complex to implement compared to the University of Pretoria system.

5. SOP FOR ARCHIVING DECISIONS (UPDSPACE ROUTE):

The reality is that not all reports are suitable for visibility on Google Scholar. To manage the process, a short Standard Operating Procedure (SOP) is shown below to assist with decision making. If a report is unsuitable for Google Scholar, it can still be uploaded onto the repository at the University, but with restricted access. The details of such a process still need to be discussed with the University.

Table 1 SOP for decision making for report uploads onto the UPDspace repository system

No	Action	Description
1	Check for completeness	Older reports, only in hard copy format, may not be suitable for scanning because of missing sections or poor-quality print. Such documents may be scanned only for storage purposes but not for sharing with a wider audience
2	Check IP and authors	The Intellectual property of the contents must be assessed according to POPIA principles and if necessary and/or possible, consent from authors may be required through a signed letter
3	Check content suitability	Not all reports are necessarily containing scientific or research projects. Reports on other issues such as farmer development or promotional/funding structure activities may be excluded from the UPDspace repository or otherwise only archived for storage purposes
4	Compile bulletin summary	Once a report has passed the first three checks, a short bulletin or abstract summarising the contents of the full report must be compiled. This bulletin will be visible to everybody once uploaded onto UPDspace, but with an embedded link to either the full report or to a designated contact person. Restricted access requiring registration can also be implemented.
5	Decide on accessibility	Together with the Trust, authors and the SAGL management team, a decision must be made whether a report can be open access as a full report or not

6	Scan	Scan the bulletin and the full report
7	Upload on UP UPDspace	Upload on the UPDspace University of Pretoria Repository.

6. INVESTIGATING A SMALL SELECTION OF MAIZE TRUST REPORTS

A selection of ten reports was evaluated for suitability as a Google Scholar-linked report in the repository. The outcomes are summarised in Table 2. Note that if a document is not suitable for Google Scholar, it can still be added to the repository, but with total restricted access.

6.1 Classification of documents – examples from the Maize Trust

Table 2

Report Title	Suitability for Google Scholar-link (Yes/No)	Comments
1. PGP Pula Imvula	No	The report focuses on farmer training material and feedback. It will need space in a repository but cannot be linked to Google Scholar
2. PGP Advanced Farmers Support Oct 2022 – Sept 2023	No	The report describes farmer support programmes, can be placed in a repository but cannot be linked to Google Scholar
3. PGP Schools programme	No	The report describes schools' information transfer for promotion of farming as a career. Again, the report can be placed in a repository but cannot be linked to Google Scholar
4. ARC Annual efficacy Evaluation of Registered Pre-emergence herbicides for control of grass weeds	Yes, but with restrictions	This work involves testing herbicides from commercial companies and cannot be made available to the open public. It can possibly be placed on Google Scholar as an abstract only with a restricted link.

5. Genetically modified maize area assessment for South Africa – 2021/22 production season	Yes, but author name needs to be provided	This report is suitable for inclusion on Google Scholar, but no author name is provided. Discussions must be held with the UP Library on how reports with no specific author names must be handled.
6. PGP Advanced Farmers Support Oct 2023 – Sept 2024	No	The report describes farmer support programmes, can be placed in a repository but cannot be linked to Google Scholar.
7. The impact of conservation agriculture on maize ear rots and resultant mycotoxin production in commercial and smallholder farming systems (P05000126). MTM 19/03 ARC	Yes	This is a scientific research project. The report can be uploaded on Google Scholar. An abstract and author details have been included. POPIA compliance must be addressed.
8. Grain SA-Maize Trust AUP Report 2022	No	This is an auditor's report with financial information. It must be archived in a repository but cannot be published on Google Scholar.
9. Baseline sensitivity and resistance mechanisms of *Exserohilum turcicum* to demethylation inhibitor fungicides in South Africa. Continuation Project	No	This is an interim report for a research project. It must be archived in a repository but cannot be published on Google Scholar due to the scientific output being incomplete.
10. Sandy Soils: Final Report	Yes	This report was used as an example for summarising into a Bulletin (see Appendix A).

6.2 Example of a summarised research bulletin (if the contents are restricted this can be shortened into an abstract only):

An example of a technical bulletin format document summarising a full report submitted to the Maize Trust is attached as Appendix A to this report. This example is like typical professionally written bulletins done by publishing houses. The summary document can also be written in such a way that it does not disclose sensitive information, while inserting a link or active email address in the document if a reader needs access to the full report. If a report can be disclosed in full, the active link can go directly to a PDF copy of the full report in the repository. Linking to an email address will require additional time and effort from the SAGL or the Trusts because a dedicated person must react to the emails and still send a scanned report to the recipient. It is not clear at this stage how such as system would be managed. The UPDspace system can restrict access, and different options can be explored once they

have installed the software at SAGL. Bulletins also need to be written by suitably qualified and experienced staff who understands the scientific nature and sensitivities of research results. This will have financial implications too because the salary of such a person must be covered. This will be the case irrespective of the repository being used.

Outsourcing of report summary writing was explored but it was found to be very expensive and at this stage it is not a viable option. For future report submissions, it can be requested that for all final reports the authors must include a short executive summary that can be used for uploading onto the UPDspace repository for visibility on Google Scholar. For older reports, a shorter version consisting of only an abstract and limited to one page can be considered. The University of Pretoria requires single page abstracts for all academic documents. If no abstract for a report exists, these will have to be written before a document can be uploaded. If a technical report already has an executive summary included, these can be used to replace an abstract and can be condensed into a single page document suitable for instant visibility applications. This approach will be much more affordable to implement than having a publishing house writing it and it can all be done in-house at the SAGL.

Please note that the example in Appendix A is only for discussion purposes. The format does not have to be similar, and no decisions have been made in that regard.

The second example is shown in Appendix B, which is the one-page abstract format typically used for a thesis on Google Scholar. This format is recommended for typical technical reports, which is an easier way of summarising and referencing and will also be less time consuming to create.

7. CONCLUSIONS, RECOMMENDATIONS AND THE WAY FORWARD

Both the University of Pretoria UPDspace and the Zenodo repositories offer good support, and both are backed by large support structures and large libraries that will continue to function independently from the SAGL or the Trusts. However, the Zenodo system currently does not place documents on Google Scholar, making access via search engines more complicated. Zenodo only gives a DOI number for each document, and these numbers must be paid for. It is also not clear exactly what the cost of using the Zenodo system will be, information on their website is incomplete and a detailed discussion with their administrator will be necessary to get a better idea.

The University of Pretoria UPDspace system assigns both URI and DOI numbers to documents free of charge. The DSpace system focuses more on scholarly type documents, but documents such as crop quality reports and specific training materials also qualify, and the University of Pretoria is very supportive of accommodating a wider range of reports, with a dedicated staff member who can visit the SAGL and assist with software and training. On the other hand, the Zenodo system, being based in CERN, Switzerland, is remote, and any software issues become

challenging to handle. With the Zenodo system, more time from a dedicated person at SAGL will be required especially for document scanning and uploads, while the University of Pretoria can assist with bulk scanning and uploading services.

Costs for the University of Pretoria system will consist mostly of time to pay for a dedicated person to be appointed at SAGL for managing and scanning of documents and possibly supporting the purchase of additional fileserver capacity if the database becomes too large. The University does have the option of bulk scanning and upload facilities for documents. For the Zenodo system, a dedicated staff member must also be appointed, but the person will be required to spend more time on scanning of documents because the support structure does not have bulk scanning systems. The Zenodo system may also be more prone to internet downtime issues and data costs via South Africa will become important. Zenodo also charges the allocation and maintenance of the document DOI numbers, which the University of Pretoria provides at no cost.

It is recommended, based on the results of this investigation, to approach the University of Pretoria for the use of their UPDspace system for uploading and managing of the Trust reports due to the wider visibility amongst the scientific community via Google Scholar, and their support structure which is much more accessible and user friendly than Zenodo.

The Zenodo system is, however, also a viable alternative to be kept as a second choice, but it will be more expensive and time consuming to operate.

APPENDIX A: EXAMPLE OF MAIZE TRUST REPORT BULLETIN SUMMARISING A TECHNICAL REPORT

APPENDIX B: EXAMPLE OF ONE PAGER THESIS ABSTRACT AS IT APPEARS IN THE UP LIBRARY DSPACE ON GOOGLE SCHOLAR

Appendix A Example of Maize Trust Report Bulletin summarising a technical report

MAIZE TRUST REPORT BULLETIN

No 1

INVESTIGATING THE IMPACTS OF CONSERVATION AGRICULTURE PRACTICES ON SOIL HEALTH AS KEY TO SUSTAINABLE DRY LAND MAIZE PRODUCTION SYSTEMS ON SEMI-ARID SANDY SOILS WITH WATER TABLES IN THE NORTH WESTERN FREE STATE.

Dr AA Nel (Agronomy)*, Dr DJ Beukes* (Soil Science), Melanie de Bruyn*, 2023.

* Sandy Soils Development Committee (SSDC/SOK).

Synopsis of the final report for the period October 2020 to September 2023 submitted to the Maize Trust (Compiled by Dr. C Erasmus).

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FOCUS POINTS

- Crop rotation between maize, a cover crop and soybeans improved maize yield by 12% over six seasons for sandy soils with a water table
- After six seasons, no changes in soil health and fertility states were observed
- After six seasons, plant parasitic nematode loads did not change, but nematode egg loads started to increase
- Maize yield on 75cm deep seasonally ripped soil was higher than no-till practices or alternate year ripping
- Timing of top dressed nitrogen fertilisation did not affect maize yield
- Top-dressed nitrogen applied 40 days after the plant date showed improved yield compared to pre-plant nitrogen applications
- Calcium Ammonium Nitrate based fertilizers performed better than urea based fertilizers
- Rainfall had a significant effect on trial success rate, with water logging being a problem during the early stages of some of the seasons, resulting into low yields.

BACKGROUND

Dryland maize crop production on sandy soils is subjected to unique challenges such as poor nutrient retention and quick water drainage. Sandy soils are often associated with high water tables due to underlying geology trapping water beneath the sandy soil layer. Therefore, when high rainfall occurs in a short time, crops can easily become waterlogged. On the other hand, when rainfall is below average, the soils will dry out very quickly, leading to severe crop damage in a short time, with often only a few weeks during a heat wave necessary to result in total crop failure.

Generally accepted good agricultural practices may not produce the expected results in sandy soils compared to other soil types. A long term experiment was undertaken by the Sandy Soils Development Committee (SSDC/SOK) on a selection of participating farmers in the North Western Free State Region of South Africa, where sandy soils with high water tables occur along with high rainfall variation between seasons as a result of the El Nino/La Nina phenomenon.

The research period covers six growing seasons and the results of 13 trials for the period October 2020 to September 2023 are summarised. Full reports are available on request (see References for links).

EXPERIMENTAL TRIALS

Cash crop Rotation vs. Maize Monoculture

Four crop rotation systems were compared over six seasons. They consisted of the following:

Abbreviation	Crop
MM	Maize Control (no rotation)
MS	Maize - Soybean alternate years
MMS	Maize - Maize - Soybean
MCS	Maize - Cover Crop - Soybean

Experimental layout was a randomised complete-block design with three replicates. Soil was cultivated with a 75cm ripper and fertilised according to each crop's requirements.

Soil Health and Nematodes

Several parameters were tested to indicate soil health. These included soil pH, Inorganic N (NO_3 and NH_4), Phosphorus, Potassium, Calcium and Organic Carbon. Samples were taken at different depths from 0 to 50cm. The effect of crop rotation on the load of root-rot nematode eggs, infection levels and species changes were tested.

Nitrogen fertilisation rates, products and application timing

The optimum nitrogen fertilization rates on sandy soil with a water table were tested. Summarised results of three trials are reported here.

Trial A was planted in November 2022. The fertilizer mixture 1:1:1 was applied at a rate of 200 kg ha^{-1}. Heavy rains drowned many seedlings and the trial was then replanted on 28 December 2022 with the cultivar PAN 491B at 27500 seeds ha^{-1}. During the replanting, 150 kg fertilizer 1:1:1 ha^{-1} was applied. The experimental design was a randomized complete-block with fertilization rates as treatments at five levels: 110, 140, 200, 250 and 310 kg N ha^{-1} with 3 replicates. Urea (46% N) was applied five weeks after planting. The final application rates or treatments were 84, 98, 126, 149 and 176 kg N ha^{-1}.

Trial B was planted on 5 January 2023 with the cultivar PAN 5R-891BR at 24 000 ha^{-1} in 0.82 m spaced rows. Fertilizer (1:1:1) was applied at a rate of 200 kg ha^{-1}. In December 2022 the land was ripped (40 cm deep) and 75 kg KCl ha^{-1} applied. During planting, 180 kg 3:2:1 ha^{-1} fertilizer was applied. The experimental design was a randomized complete block design with fertilization rates as treatments at six levels: 75, 125, 175, 225, 275 and 325 kg 1:0:0 ha^{-1} and five replicates. These treatments were applied four weeks after planting.

In Trial C, application timing of various fertilizer types, mixtures and inhibitor levels were tested. The two application times were one or two days before planting (preplant application mixed into soil) and at 40 days after planting (top-dressed). The trial layout was a randomized complete block design with four replications.

Ripping vs. no-tillage

Over a six year (six seasons) period, the effect of ripping of the soil vs no tillage on maize yield was investigated at different farms for sandy soils with a water table.

RESULTS AND DISCUSSION

Cash crop Rotation vs. Maize Monoculture

Seasonal variation had the strongest effect on maize yield, while crop systems and crop system x seasons interaction effects on yield were also observed. Mean seasonal yields varied from 2.90t ha^{-1} in 2021/22 due to water logging, to 6.59t ha^{-1} in 2019/20. Over the entire study period, the Maize - Cover crop - Soybean (MCS) rotation systems performed the best. Average maize yield for the MCS rotation system was 5.35t/ha while average yield for monoculture maize was 4.64t/ha for similar fertiliser systems. Waterlogging during some of the seasons significantly reduced crop yields. Typical cover crops tested were cowpea, pearl millet, sorghum/Sudan grass hybrid, forage sorghum and dolichos (summer legume).

Soil Health and Nematodes

Soil health and most soil parameters were low or below average. The lower threshold of soil organic carbon for soil functionality is between 1.5% and 2.0% (Lal, 2016). Values of 0.17% to 0.22% soil organic carbon (SOC) were seen for these trials, which were very low. Therefore, the soil health system in these trials could never reach full functionality.

Plant-parasitic nematode eggs of the genera *M. incognita* and *M. arenaria* and *Pratylenchus* spp. increased significantly over the study period. Increases were the highest for the maize-cover crop-soybean (MCS) and the maize-maize-soybean (MMS) systems. In spite of this, the MCS system still gave the highest yields of maize ha^{-1}. Nematodes were problematic in the Cover crops such as Cowpea (Figure 1). Cultivar selection for nematode resistance of cover crops should be considered.

Figure 1 Severe root-rot nematode knots in infected Cowpea, 2021/2022 season.

Nitrogen fertilisation rates, products and application timing

Trial A Yield was significantly affected in this trial, with Figure 2 showing the relationship between Nitrogen rate and tons per hectare (t/ha). Yield initially increased with increase in fertilisation rates, but reached a plateau at around 140kg ha-1 Nitrogen fertilization rate.

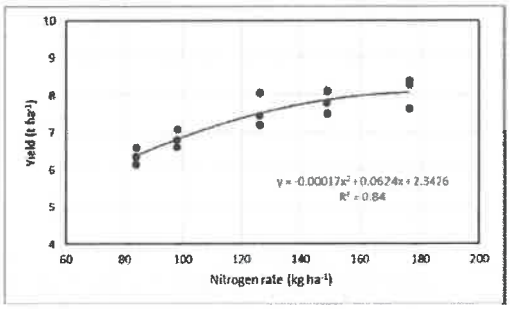

Figure 2 Yield response to top dressed nitrogen rates at the farm "Springboklaagte" in 2022/23 with urea as nitrogen source.

Trial B Yield was not significantly affected in this trial, with Figure 3 showing no relationship between Nitrogen rate and tons per hectare (t/ha).

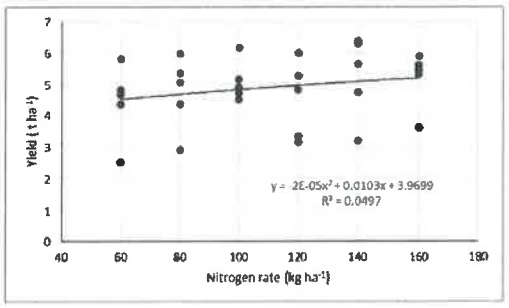

Figure 3 Yield versus the top dressed nitrogen application rate at the farm "Arbeidadel" in 2022/23 with 1:0:0 fertilizer as nitrogen source.

Increase in fertilization rate did not increase maize yield (Figure 3). Repeatability was very poor for each application level (x-axis values).

This demonstrated the problematic issue with sandy soils in terms of experimental trial repeatability and statistical significance due to soil properties affecting the fertiliser efficiency due to either waterlogging or leaching. Waterlogging early in the growing season is a recurring problem that kills seedlings or prevents any emergence of seedlings at all. Due to the high costs of fertiliser, innovation is needed in how to mitigate these challenges by investigating alternative ways to apply fertiliser or soil treatments.

Trial C

The timing of the application of fertilizer consistently showed that it is better to do a top dressing type application than a pre-planted application for sandy soils with a water table (Figure 4). The exact reasons for this phenomenon are not well understood.

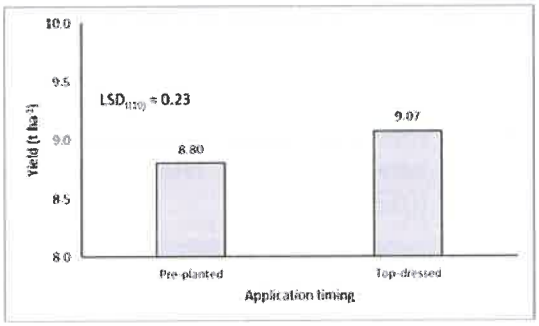

Figure 4 The effect of nitrogen fertilizer application timing on the yield of maize at the farm "Erfdeel" in 2022/23. Application timing was one or two days before planting (pre plant) and 40 days after planting (top-dressed).

Ripping vs. no-tillage

For sandy soils with a water table, it was found that over a six year test period that ripping of the soil to 75cm produced better yields of maize compared to the yields of no-till practices. Therefore, for sandy soils it can be concluded that no-till practices in its current form are not effective.

The effect of waterlogging is illustrated in Figure 6, where a yield map shows the yield variation over a piece of land of 21ha, divided up into treatment plots. Water logging caused some plots to have almost no yield at all.

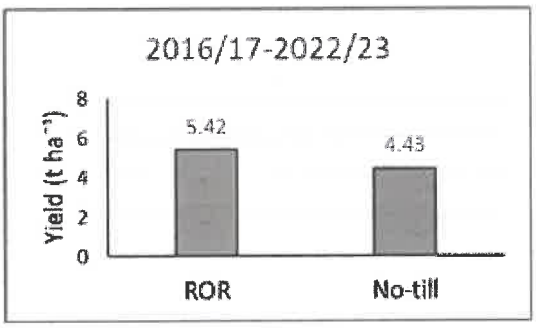

Figure 5 Comparison between the yield of maize of the rip-on-row (ROR) and no-till systems from 2016/17 to 2022/23, for all test areas combined.

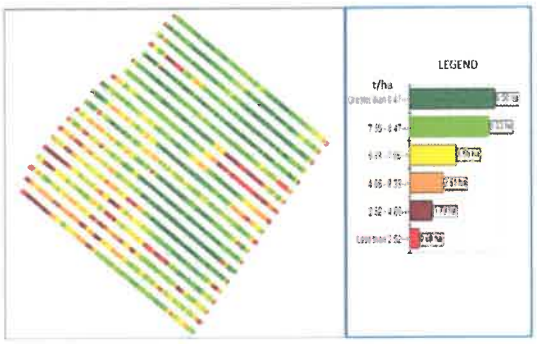

Figure 6 Yield map of a 21 ha trial area showing the large yield variation due to water logging. Strips represent treatment plots.

CONCLUSIONS

Although sandy soils with water tables often occur on farms in the semi-arid tropics (for example the South African maize growing

regions), specific data on cultivation practices for these soils is lacking. This project illustrated the need for better understanding and innovation to mitigate the challenges faced by these farmers, where conventional knowledge about agronomical practices such as fertilization types and rates may not apply to these soils.

SCIENTIFIC OUTPUTS

De Bruyn MA, Nel AA, Van Niekerk JA., 2022. Views and perspectives of local farmers on crop diversification in the North-Western Free State, South Africa. *African Journal of Agricultural Research*. 18 (11): 1006 1012. https://doi.org/10.5897/AJAR2022.16150

De Bruyn, MA., Nel, AA., & van Niekerk, JA., 2023. The effect of crop rotation on soil health in the north-western Free State region, South Africa. *South African Journal of Plant and Soil*, 40(4–5), 254–261. https://doi.org/10.1080/02571862.2023.2282504

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Fourie, D., 2023. *Nematode report for a conservation agriculture rotation trial (2021, 2022 and 2023 growing seasons) and a nematicide trial done at Christinasrus, near Wesselsbron, Free State province, South Africa*. North West University, Unit for Environmental Sciences and Management Sub-program: Integrated Pest Management Private Bag X6001, Potchefstroom 2520, South Africa Web: http://www.nwu.ac.za.

Lal R. 2016. *Soil health and carbon management*. Food and Energy Security, 5 (4): 212–222.

BULLETIN PUBLISHED: September 2025

For full report request: admin@sagl.co.za

Website: www.sagl.co.za

Appendix B Example of one pager thesis abstract as it appears in the UP Library DSpace on Google Scholar

Maize kernel translucency measurement by image analysis and its relationship to vitreousness and dry performance

Files

00front.pdf (205.54 KB)
01chapters1-2.pdf (1001.89 KB)
02chapter3.pdf (1.99 MB)
04chapters4-6.pdf (682.44 KB)
05back.pdf (139.31 KB)

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Date

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Authors

Erasmus, Corinda

Publisher

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Abstract

A rapid non-destructive Image Analysis (IA) technique was developed for the determination of maize kernel endosperm vitreousness. Kernels were analysed using a Leica Q-Win Q500 IW-DX Image Analyser fitted with Leica Q-Win software and connected to a Sony XC-75 CCD camera. Kernel translucency measurements were optimised by using a light system that involved positioning whole kernels on top of a mask containing round illuminated areas (circles), smaller than the projected areas of the kernels, allowing light to shine through the kernels only. Correction factors allowing for constant illumination of kernels were developed to adjust for kernel size variation in relation to constant light area. Similarly, a correction factor for the effect of kernel thickness on detected translucency values were developed. Significant correlations were found between corrected translucency values and vitreous and opaque endosperm yields as determined by hand dissection. These were: translucency as a percentage of the whole kernel and vitreous endosperm (mass%) (Translucency 1), r = 0.77, p<0.00001, and Translucency 1 and opaque endosperm (mass%), r = -0.72, p<0.00001 for white maize. Similar correlations were found for translucency as a percentage of endosperm (Translucency 2). Correlation coefficients increased significantly after kernel thickness corrections. Significant negative correlations were also found between corrected translucency values and Floating Number. For yellow maize, Translucency 1 correlation coefficients was r = 0.78, p<0.00001 and r = -0.71, p<0.00001 respectively with similar correlations for Translucency 2. Correlations were obtained after applying both correction factors for exposure and thickness. The IA technique was evaluated for predicting the yield of vitreous endosperm products during dry maiz~ milling in laboratory and industrial-scale milling trials. Significant positive correlations were found between corrected translucency values and yields of milling products from vitreous endosperm. Experiments using a laboratory-scale experimental roller milling test without a degerming stage produced the following correlations: between Translucency 1 and semolina yield (mass%), 0.74, p<0.001 and Translucency 2 and semolina yield (mass%), 0.70, p<0.001. For industrial-scale milling, a Bühler industrial-scale maize mill (3 tons per hour) was used. The correlation between Translucency 1 and extraction at degermer (degermer overtail yield) was 0.93, p<0.0001. There was a similar correlation for Translucency 2. Yellow maize was degermed using a pilot-scale Beall-type degermer and the correlation between Translucency 1 and flaking grits> 3.9 mm was 0.67, p< 0.001. The IA technique permits the non-destructive analysis of maize endosperm translucency on large samples of single kernels. It is suitable for rapid quantification of maize endosperm contents and predicting dry maize milling performance, as kernel translucency was significantly correlated with vitreousness in all instances. With further development of specific hardware and software, the technique has potential as an on¬line maize kernel classification system in industrial mills. As the method is non¬destructive, it is also suitable for classification of maize seed breeding material. It is also a potential method for the measurement of maize opacity as used by the wet milling industry, where opacity (the opposite of vitreousness) is related to maize starch yield.

Description

Thesis (PhD (Food Science))--University of Pretoria, 2003.

Keywords

Corn milling, Image analysis, Corn quality, UCTD

Citation

Erasmus, C 2003, Maize kernel translucency measurement by image analysis and its relationship to vitreousness and dry milling performance, PhD thesis, University of Pretoria, Pretoria, viewed yymmdd < http://hdl.handle.net/2263/24228 >

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