



<b>Reg no. IT8214/98</b>		
<b>c/o L&amp;L Agricultural Services</b>		
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**Maize Production Research Application Form**

<b>Date of Application:</b>	23 August 2021
<b>Type of Application (New or Continuation):</b>	New
<b>Title of Research Project:</b>	Annual efficacy evaluation of registered pre-emergence herbicides for the control of grass weeds
<b>Name and Trading Name of the Institution/Employer:</b>	ARC-Grain Crops
<b>Name of Lead Researcher:</b>	Dr Maryke Craven
<b>Contact details of Lead Researcher</b> <i>E-mail address:</i> <i>Phone:</i>	<a href="mailto:CravenM@arc.agric.za">CravenM@arc.agric.za</a> 018 2996346 083 3663662
	Two-years 1 April 2022 - 31 March 2024
<b>Amount Required for 1st year of study:</b>	<b>R282 369 (R141 185 MT 50%)</b>

**1. Brief outline of project (250 words)**

*Please provide a description of the project as an abstract.*

The use of pre-emergence herbicides help maximize yields, regardless of the production system, through the early effective and lasting weed control they provide. Annually herbicides constitutes approximately 9% of input costs. Due to patent expiration, current day producers have access to a vast range of more affordable weed control options in the form of generic herbicides. Although generic versions of a brand name have the same active ingredient, such products may not necessarily constitute the same quality or amount of active ingredient as its brand name counterpart, potentially performing less effective. No independent platform currently exist in which generic pre-emergence herbicides can be evaluated for their efficacy. The current proposed project aim to evaluate all locally registered pre-emergence herbicides (as per Agri-Intel website) and compare their efficacy within similar formulation groups across two soil types (16% and 35% clay) in both early and late application trials.

## 2. Rationale (max 1000 words)

The rationale should include 1) the problem statement 2) the unique opportunity being pursued/novelty of project (i.e. why is the project necessary or important?) and 3) an overview of key studies to illustrate work conducted previously (include relevant references).

### *Problem statement:*

The use of pre-emergence herbicides help maximize yields through the early, effective and lasting weed control they provide. The weed competition free environment created during the initial, critical growth stages of the crops, aids in subsequently ensuring better crop establishment. Their use can in addition help to minimize post-emergence herbicide applications or protect against early-season weed competition when the timely post-emergence application is prohibited due to weather or busy work schedules. Due to patent expiration, current day producers have access to a vast range of more affordable weed control options in the form of generic herbicides. Although generic versions of a brand name have the same active ingredient, such products may not necessarily constitute the same quality or amount of active ingredient as its brand name counterpart, potentially performing less effectively. No independent platform currently exist in which generic pre-emergence herbicides can be evaluated for their efficacy.

### *The unique opportunity being pursued/novelty of project (i.e. why is the project necessary or important?):*

Due to economic pressure experienced by producers, it is essential to ensure the most effective weed control programme at the most economically justifiable means. Due to the extensive range of generic products on the market, producers have greater access to more affordable weed control, but have voiced the need at various platforms in the past that the efficacy of such products be compared. The need for the evaluation of efficacy of grass control achieved by generic products by an independent institution accordingly exists that would ensure unbiased results which would aid producers in management practices and decisions. Information generated through such a project would aid producers in their management practices and decision making processes.

### *An overview of key studies to illustrate work conducted previously:*

Weed interference can cause between 20% and 50% yield losses in maize (Kropff and Spitters, 1991; Ngouajio *et al.*, 1999; Kim *et al.*, 2002; Parker *et al.*, 2004). Locally, weed control annually constitutes approximately 9% of input costs (Fourie, 2021) and as economic pressure on producers is increasing, producers have little leeway for ineffective or substandard weed control.

A generic herbicides refers to herbicides that contain the same chemical substance as an herbicide that was originally protected by patent rights. Due to limited or no research costs associated with their development, generic herbicides often have a lower initial product cost than their brand name counterparts. According to McFalls *et al.*, 2015, purchase price of herbicides should, however, not be the only aspect of importance when selecting an herbicide, with factors such as effectiveness, application rates and/or procedures as well as product availability all requiring consideration. Whilst generic products have the same active ingredients than the original brand name herbicides, generic and brand name herbicides are not required to have the same inactive ingredients (McFalls *et al.*, 2015). For soil applied herbicides, the inactive ingredients would as an example influence handling and mixing properties of the formulation (McFalls *et al.*, 2015). The formulation of a generic product's active ingredient may accordingly differ from that of the brand name whilst generic manufacturers may use different technologies to produce active ingredients.

Generic and brand name herbicides can furthermore differ from each other regarding the physical form of the active ingredient, for example where the elements of the molecules are arranged slightly differently with the s- and r- isomers of metolachlor being an example of the latter. S-isomeres are more active than r-isomeres, and will accordingly, if applied at the same concentration, be more effective than the r-isomere counterpart. McFalls *et al.* (2015) states that the generic product may have a cheaper price but may thus not include the same amount and quality of active ingredient as the brand-name product. More of the generic material may need to be used or more applications required in order to achieve an equivalent rate of active ingredient, thereby potentially eliminating whatever cost savings was realized at the initial purchase of the generic product.



**Photo 1:** Efficacy research trials to compare Pre-emergent herbicide formed part of the P05000023 project which came to a close during March 2020

During March 2020, an ARC/Maize Trust co-founded project titled “*Improved grass control systems in maize*” reached its end after a long but fruitful run of 20 years. One research activity which formed part of the P05000023 (000332) research project was the annual evaluation of pre-emergence grass herbicides for their efficacy to control grass weeds on two soil types (Photo 1). After consultation with various stakeholders regarding future required research in weed control, the suggestion was made that this annual evaluation of newly rehearsed pre-emergence products be continued. The current proposal is accordingly submitted for consideration for co-funding by the Maize Trust.

#### *Reference list*

FOURIE, P., 2021. Preliminary production cost and budgets for the new season. Grain SA presentation.

KIM, T.J., NEAL, J.C., DITOMASO, J.M. & ROSSI, F.S., 2002. A survey of weed scientists' perceptions on the significance of crabgrasses (*Digitaria* spp.) in the United States. *Weed Technology*, 16: 239 - 242.

KROPFF, M.J. & SPITTERS, C.J.T., 1991. A simple model of crop yield loss from early observations on relative leaf area of the weeds. *Weed Research*, 31: 97 - 105.

NGOUAJIO, M., LEMIEUX, C. & LE ROUX, G.D., 1999. Prediction of corn (*Zea mays*) yield loss from early observations of the relative leaf area and the relative leaf cover of weeds. *Weed Science*, 74: 297 - 304.

PARKER, R.G., YORK, A.C. & JORDAN, D.L., 2004. Evaluation of herbicide programmes in no-till and conventional tillage corn. 26<sup>th</sup> Southern Conservation Tillage Conference pp. 312 - 317.

McFALLS, J., Yi Y-J, Li, M-H & SENSEMAN, S. 2015. Evaluation of generic and branded herbicides: Technical report. TEXAS A&M TRANSPORTATION INSTITUTE College Station, Texas, <http://tti.tamu.edu/documents/0-6733-1.pdf>

### **3. Research objectives and aims**

Objective: Evaluate and compare efficacy of pre-emergence herbicides on grass control in maize

Aim 1: To evaluate the efficacy of selected pre-emergence herbicides through field trials conducted at two application times (early and late) on two soil types (16% clay and 35% clay).

### **4. Relevance and importance to the South African maize industry**

*Please provide an explanation of how the project was conceptualized, stakeholders consulted and the envisaged benefits to the industry.*

With weed interference potentially causing up to 50% yield losses in maize, the procurement of herbicides by local producers for their weed control programmes annually constitutes approximately 9% of input costs (Fourie, 2021). As economic pressure on producers is increasing, producers have little leeway for ineffective or substandard weed control. Producers will understandably most often opt for more affordable control, which is available in the form of generic products. The current proposed project provides an independent evaluation of such generic products, to ensure that producers receive value for their money. As the degree to which various grass species are controlled in the various field trials will be monitored, lack of effective or sufficient control by specific herbicides observed for specific grass species can be reported, and further investigated through glasshouse studies should the need arise.

### **5. Research design**

*Please provide specifics of the research approach. Trials or experiments planned, replications, etc. Supply enough information for peer-review purposes and supply key references where necessary.*

All registered pre-emergence herbicides for use in maize as listed on Agri-Intel will be annually included in the trial, dependant on availability. Table 1 provides a list of 28 registered herbicides currently registered for use in South Africa, with the original brand product indicated in bold. Not all a.i. groups still have the original brand product available, but trials are set up in such a manner that efficacy comparison will be conducted for herbicides with the same formulation. Two trials (early vs late planting date) will be conducted during 2022/23 and 2023/24 respectively on two soil types (Potchefstroom – 35% clay and Bethlehem - 16% clay) in order to compare the efficacy achieved by a minimum of 15, maximum of 28, commercially available herbicides with the same active ingredient formulation.

The trials will be planted as completely randomised designs with three replicates. Each plot will be 15m<sup>2</sup> in size and flanked on all sides by control plots (5m<sup>2</sup>). In order to control broad leaves and nutsedge in all plots, a standard application of bendioxide (Basagran - 3 l /ha) and bromoxynil (Voloxynil -1.5 l /ha, for *Amaranthus*

control) as well as halosulfuron-methyl (Sevian - 50 g/ha), will be applied 3 weeks after the pre-emergence applications across all plots. Applications will be made with a CO<sup>2</sup> knapsack operated sprayer and boom (2.5m boom width - 4x 8004 teejet nozzles). The use of the knapsack operator unit, will allow for less space required to screen a maximum of 28 products. Products with similar active ingredients will be applied at the same rate in order to compare their efficacy. The lowest label rate will be selected for every product. Plots will be monitored every second week for a period of three months and the %control achieved as well as weed species compilation will be noted.



Photo 2: The efficacy of pre-emergent herbicides was previously evaluated as part of a larger grass control project (P05000023) which came to a close in March 2020.

**Table 1:** Pre-emergent herbicides registered for maize (Agri-intel).

Product no	Trade name	Active ingredient	g ℓ <sup>-1</sup>	Registration holder
1	Crocodile	acetochlor	750	Arysta LifeScience South Africa (Pty) Ltd
2	Saffier 750	acetochlor	750	Arysta LifeScience South Africa (Pty) Ltd
3	Acetochlor 900 EC	acetochlor	900	Arysta LifeScience South Africa (Pty) Ltd
4	Acetogan 900 EC	acetochlor	900	Adama South Africa (Pty) Ltd
5	Acetochlor 700 EC	acetochlor + dichlormid	700	Nulandis
6	Acetochlor 700 EC	acetochlor + dichlormid	700	Villa Crop Protection (Pty) Ltd
7	Lion	acetochlor + dichlormid	700	Volcano Agroscience (Pty) Ltd t/a Arysta LifeScience South Africa (Pty) Ltd
8	Buffalo	acetochlor + dichlormid	840	Volcano Agroscience (Pty) Ltd t/a Arysta LifeScience South Africa (Pty) Ltd
	<b>Lasso</b>	<b>Alachlor</b>		<b>Monsanto</b>
9	Alachlor 384 EC	alachlor	384	Universal Crop Protection (Pty) Ltd
10	Alanex 384 EC	alachlor	384	Adama South Africa (Pty) Ltd
11	Frontier Optima (720)	dimethenamid-P	720	BASF South Africa (Pty) Ltd
12	Intelex (68g and 600)	dimethenamid-P + saflufenacil	600/68	BASF South Africa (Pty) Ltd
<b>13</b>	<b>Callisto 480</b>	<b>mesotrione</b>	<b>480</b>	<b>Syngenta South Africa (Pty) Ltd</b>
14	Cantron 480 SC	mesotrione	480	Villa Crop Protection (Pty) Ltd
15	Mesoflex 480 SC	mesotrione	480	Adama South Africa (Pty) Ltd
16	Premiere 480	mesotrione	480	Meridian Agrochemical Company (Pty) Ltd
17	Clincher 960 EC	metolachlor	960	Adama South Africa (Pty) Ltd
18	Metolachlor 960	metolachlor	960	Arysta LifeScience South Africa (Pty) Ltd
19	Tolla 960	metolachlor	960	Volcano Agroscience (Pty) Ltd t/a Arysta LifeScience South Africa (Pty) Ltd
20	Metolachlor 915EC	metolachlor + benoxacor	915	Universal Crop Protection (Pty) Ltd
21	Platinum Plus 915 EC	metolachlor + benoxacor	915	Villa Crop Protection (Pty) Ltd
22	Metolachlor 800 EC (L7137)	metolachlor + benoxacor	800	Universal Crop Protection (Pty) Ltd
23	Metolachlor 800 EC (L7433)	metolachlor + benoxacor	800	Villa Crop Protection (Pty) Ltd
<b>24</b>	<b>Dual Gold</b>	<b>s-metolachlor</b>	<b>915</b>	<b>Syngenta South Africa (Pty) Ltd</b>
25	Pentium 960 EC	s-metolachlor	915	Universal Crop Protection (Pty) Ltd
26	Signet 915 EC	s-metolachlor	915	Meridian Agrochemical Company (Pty) Ltd
27	Palladium Plus 915 EC	s-metolachlor + benoxacor	915	Villa Crop Protection (Pty) Ltd
28	Smeeto 915 EC	s-metolachlor + benoxacor	915	Nulandis

## 6. Deliverables and milestones

*Please present the main deliverables which will be delivered by the end of the study.*

*Please present bi-annual milestones which represent key stages in the project.*

See <https://www.clarizen.com/milestone-vs-deliverable-whats-the-difference/> for more information.

### Short-term objectives/activities

2022/23 Evaluate and compare efficacy of pre-emergence herbicides on grass control in maize

1<sup>st</sup> Quarter (Apr - Jun): 2022

- Market research to identify latest pre-emergence herbicides.
- Procurement of herbicides.
- Maintenance of application equipment.

2<sup>nd</sup> Quarter (Jul - Sep): 2022

- Trial site identification.
- Initial soil preparations.

3<sup>rd</sup> Quarter (Oct - Dec): 2022

- Initiate, monitor and maintain field trials (trials 1 and 2) at both Bethlehem and Potchefstroom
- Data capturing

4<sup>th</sup> Quarter (Jan - Mar): 2023

- Monitor field trials.
- Data capturing and analyses

2023/24 Evaluate and compare efficacy of pre-emergence herbicides on grass control in maize.

### Activities

1<sup>st</sup> Quarter (Apr - Jun): 2023

- Data analyses and interpretation.
- Identification of new product to be included through Agri-Intel.

2<sup>nd</sup> Quarter (Jul - Sep): 2023

- Initial field preparation.
- Prepare and submit annual report to Maize Trust

3<sup>rd</sup> Quarter (Oct - Dec): 2023

- Initiate field trials and monitoring.

4<sup>th</sup> Quarter (Jan - Mar): 2024

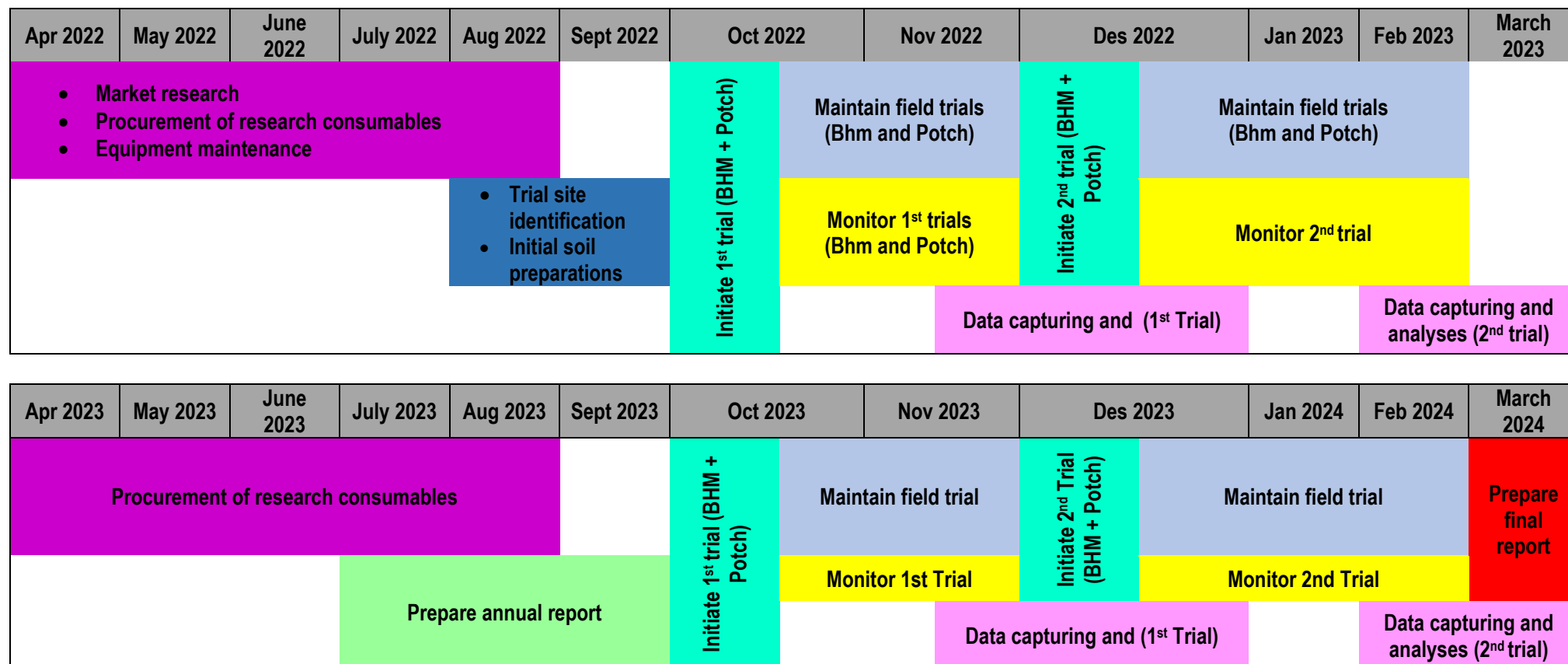
- Monitoring of field trials.
- Data capturing and final report writing.

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## 7. Gant Chart

Please include a detailed Gant chart to portray the expected timelines of the project.

**Table 2:** Gant Chart of proposed project.



## 8. Budget and budget justification

Please present the detailed budget for the full duration of the study, per individual year, as well as co-funding. Clearly indicate the amounts requested from the Maize Trust (per year) for the duration of the project. State how each item of expenditure is relevant to the project, and how the amounts have been calculated (e.g. give a breakdown of travel costs per km, number of trips, etc. instead of only a total for travel cost).

The following items are not eligible for funding:

- The cost of main investigator salary to undertake the research
- Bursary costs (Please refer to <https://agrimanage.co.za/> for bursary applications)
- Insurance costs; and
- Reimbursement of previous expenditure

NB: Overheads should not exceed 15% of budget and any overseas travel costs and capital expenses should be specified.

**Table 3:** Budget of proposed project

Item	Project total amount	Amount requested from MT	Maize Trust %	Justification
<b>Year 1</b>				
Project Budget Total	R282 369	R141 185	50%	Detailed in Table 3
Subtotal year 1	R282 369	R141 185		
<b>Year 2</b>				
Project Budget Total	R175 990	R87 995	50%	Detailed in Table 3
Subtotal year 2	R175 990	R87 995		
<b>Total of Project over 2 years</b>	<b>R458 359</b>	<b>R229 180</b>		

<b>FY 2022-23</b>	<b>Project Nr</b>
<b>Detailed Budget</b>	<b>0</b>
<b>Expenses</b>	<b>Budget R</b>
Personnel time	93 245
Meetings	-
Travel & accommodation	15 700
Other personnel costs (Registration)	3 000
Part time employees	3 420
ARC Fleet costs	15 280
Services: Project specific direct costs	1 500
Rent (External & ARC internal from other institutes)	-
Contract services	-
Research consumables	97 330
Diagnostic, lab and PR services	-
Library (Project relevant books, journals and publications)	-
Shows and exhibitions	-
Resource requirements	16 063
Overheads	36 831
<b>Total</b>	<b>282 369</b>

**Table 4:** Cost breakdown over two years

<b>Expenses</b>	<b>2022-23</b>
Personnel time	93 245.00
Travel & accommodation	
• spraying of field trials (2 people x 1night x 4 trials @ R1400)	15 700.00
• S&T allowance R450 per day (2 people x 5 days planting and screening)	
Other personnel costs (Registration):	
Registration with SACNASP and SASCP	3 000.00
Part time employees	3 420.00
ARC Fleet costs	
• 4x spraying trips @700km	
• 6 screening trips x 2 plantings @700km	15 280.00
• Local trial monitoring (2 sites)	
Services: Project specific direct costs:	
•Combined congress attendance fee	1 500.00
Research consumables	
•28 Pre-herbicides, PPEs (3 personnel), T-markers, CO2 gas bottles	97 330.00
Resource requirements	
•Facility costs - farm section (cultivation, seedbed preparation, herbicide application) - 4 trials	16 063.00
Overheads (15%)	36 831.00
<b>Total</b>	<b>282 369.00</b>
<b>Expenses</b>	<b>2023-24</b>
Personnel time	98 840.00
Travel & accommodation	
• spraying of field trials (2 people x 1night x 4 trials @ R1400)	16 642.00
• S&T allowance R450 per day (2 people x 5 days planting and screening)	
Other personnel costs (Registration):	
Registration with SACNASP and SASCP	3 180.00
Part time employees	3 625.00
ARC Fleet costs	
• 4x spraying trips @700km	
• 6 screening trips x 2 plantings @700km	16 197.00
• Local trial monitoring (2 sites)	
Services: Project specific direct costs:	
•Combined congress attendance fee	1 590.00
Research consumables	
• PPEs (3 personnel), T-markers, CO2 gas bottles, broad leaf herbicide	5 000.00
Resource requirements	
•Facility costs - farm section (cultivation, seedbed preparation, herbicide application) - 4 trials	10 155.00
Overheads (15%)	21 761.00
<b>Total</b>	<b>175 990.00</b>

## 9. Risk and mitigation plans

Identify main risks which threaten the success of projects as well as strategies to overcome these.

Untimely rainfall or lack of rainfall is the primary risk factor. Two trials per site will be conducted in order to spread the risk of too heavy rainfall after application which might leach pre-emergence herbicides out of the soil profile after application. Where possible, irrigation will be applied, should rainfall not fall within 7 days after application.

## 10. Co-workers

Name	Affiliation	Role/contribution
Liesl Morey	ARC-Biometry Unit	Statistical analyses and trial layout verification and optimization
Dr AEJ Saayman du Toit	ARC-Grain Crops	Research Team Manager, weed scientist

## 11. Names of reviewers (provide the names and contact details of 4 South African reviewers)

Names of South African reviewers	Institute, e-mail address and association with applicant
Dr PJ Pieterse	Stellenbosch University, <a href="mailto:pjp@sun.ac.za">pjp@sun.ac.za</a> , Interaction through Herbicide Resistance Action Committee (HRAC) activities. Dr Craven is currently the HARC secretary
Prof Juan Vorster	University of Pretoria, <a href="mailto:Juan.vorster@fab.up.ac.za">Juan.vorster@fab.up.ac.za</a> . Interaction through SASCP committee activities as well as Herbicide Resistance Action Committee (HRAC) activities. Dr Craven is currently the HARC secretary. Also reviewer of UP MSc studies.
Mr E. Eksteen	Syngenta, <a href="mailto:erik.eksteen@syngenta.com">erik.eksteen@syngenta.com</a> . Interaction through Herbicide Resistance Action Committee (HRAC) activities. Dr Craven is currently the HARC secretary
Prof C Reinhardt	North West University. <a href="mailto:dr.charlie.reinhardt@gmail.com">dr.charlie.reinhardt@gmail.com</a> . Interaction through Herbicide Resistance Action Committee (HRAC) activities. Dr Craven is currently the HARC secretary
<b>Reviewers to be excluded</b>	

## 12. Signatures of Applicant and Research Authority (to be completed in full)



Dr M Craven  
Snr Researcher

Potchefstroom

1 September 2021

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**Name and Signature of Applicant; Place and Date**

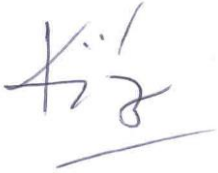


Dr AEJ du Toit  
Research Team Manager

Potchefstroom

1 September 2021

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**Name, Signature and Position of Authorized Manager; Place and Date**



Dr K Masingaidze  
Snr Research Manager

Potchefstroom

1 September 2021

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**Name and Signature of Applicant; Place and Date**

*The Manager, by his/her signature, warrants that he/she is authorised to submit this application and hereby accepts the Maize Trust's Norms and Conditions for funding on behalf of the applicant.*