Top 10 research projects in agri for 2018

Ursula Human of AgriOrbit approached several research institutions and agricultural organisations to find out which research projects they are starting or completing in 2018. Below is a list of ten interesting and important agricultural research projects in no specific order.

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1. Soil

Healthy soil is the foundation of sustainable agricultural activities and, according to Dr Gerhard Nortjé, senior lecturer at the Department of Environmental Sciences at Unisa, soil research should also form an "integral part in any conservation efforts in wildlife-protected areas." Nortjé's hypothesis is that "when the soil is degraded, the vegetation dies" which will lead to a reduction in herbivores and their predators and eventually tourists.

Studies in the Kruger National Park have shown that soil surface crusting and sub-soil compaction directly affects the vegetation, as well as the recovery of the soil and vegetation. Nortjé's PhD study in the Kruger National Park has also shown that game drive vehicles damage the surface soil structure, which leads to soil crust formation and subsurface compaction. The most important finding of this study is that off-road driving has strong negative impacts on soil crusting and sub-soil compaction.

"Correct soil management should form the basis of soil research in protected areas and game farms in the future. Research is currently being initiated on the development of bare soil patches because of overgrazing, which do not recover due to soil surface crusting, and the prevention of bare patches and the recovery thereof once it happened," says Nortjé. Click here for more information.

2. Macadamias

Barry Christie, operations manager for macadamias at the South African Subtropical Growers' Association shared the following research projects that they are excited about in 2018. Although none of the research projects is new, they are still of the utmost importance to the macadamia nut industry.

The Macadamia Protection Programme (MaPP), launched in 2017, is a project lead by the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria and the Southern African Macadamia Growers' Association. Dr

Gerda Fourie is the lead researcher for this project and will focus on pests and diseases in the macadamia nut industry. The overall focus of the MaPP will be to assist in the development of commercially viable biological control options, as well as alternative management strategies. The programme will also assist in the selection of resistant or tolerant cultivars.

A project run by Willem Steyn, a nematologist at the Tropical and Subtropical Crops division of the Agricultural Research Council (ARC), could possibly provide answers in the field, or rather in the orchard, this year. Steyn's research focuses on the use of nematodes to control macadamia pests.

A research project led by prof Ben Botha and André Botha in collaboration with Insect Science, that focuses on stinkbug control, has been running for a few years and will continue to do so for a few more years. Stinkbugs cost the macadamia industry between R190m and R320m annually. Their research is looking into the use of kairomones – chemical substances emitted by organisms. In 2017 these two researchers succeeded in attracting and trapping the two-spotted stinkbug using kairomones. Although this research is still far from commercialisation it shows the potential of this method to improve stinkbug control.

3. Biofuel

The ARC's Institute for Agricultural Engineering always has some interesting research up their sleeves. This institute is conducting several research projects centred on generating knowledge and developing sustainable technologies and processes for the bioenergy sector. Such projects include investigating the product spectrum of a food waste anaerobic biorefinery; promoting organic waste-to-energy and other low carbon technologies in small, medium and micro enterprises (SMMEs) scale: Accelerating biogas market development in South Africa; bio-ethylene production from crude glycerol; optimisation of biochemical and thermochemical waste-to-energy conversion routes.

Additionally, the Institute has embarked on setting up a bio-energy laboratory to service the emerging bio-energy sector. The laboratory is equipped with state of the art equipment (High-Performance Liquid Chromatography (HPLC), Gas Chromatography, Automated Biomethane Potential (BMP) analyser, multiple fuel analyser, inductively coupled plasma, near- infrared spectroscope, essential oils distillation unit, biodiesel plant, screw press, and tensile strength tester).The laboratory offers services such as biomass feedstock characterisation and screening, rapid BMP tests for biogas feedstock, process parameter optimisation and analysis and characterisation of various bio-products such as biogas, bio-hydrogen, VFAs, alcohols, organic solvents, bio-digestate, bio-char, bio-oil, bio-ethanol, essential oils, etc.

4. Fruit

The leading research in the fruit industry is as varied as is the industry itself. Hortgro Science, the research department of the deciduous fruit industry body, has 116 research projects running this year that cover the entire value chain. Research is divided into three main areas namely, crop production, crop protection and post-harvest sectors. For crop production water use is taking centre stage this year, especially due to the severe drought in the Western Cape, the main fruit production area of South Africa. The following research projects focus on water use:

• Water requirement of high yielding apple orchards.
• Water use of pome and stone fruit: Knowledge status, relevance and gap analysis.
• Water stress tolerance of different apple rootstocks.

For crop protection, alternative pest management in the form of biological control is the main focus. This is partly due to the increased concern of pesticide residue on fruit exported to Europe and other countries. Examples of biological control projects that are running this year:

• Pre-harvest biological control of insect pests.
• Postharvest biological control of pests and diseases.
• Alternatives for managing apple replant disease.

Postharvest research is mainly aimed at improving shelf-life and food safety. It includes the following research:

• Management of superficial scald in apple and pears in the absence of diphenylamine (DPA).
• Implementation of next-generation packaging systems in high cube refrigerated containers for efficient cooling and improved volume usage.
• Purification of antimicrobial lipopeptides produced by Bacillus spp. for biological control of postharvest phytopathogens in the perishable fruit industry.
• Application of postharvest edible coatings to alleviate shrivel in plums and nectarines.

5. Livestock

Prof Michiel Scholtz, specialist researcher at the ARC for animal production in Irene, shared information on research being done on “broken genes”.

"Selection for many of the traditional traits will increase production, but not necessarily productivity or efficiency of production. The trait with the biggest effect on the efficiency of production in beef cattle is the frequency at which a calf is produced. The contribution of fertility to the cow’s efficiency of production varies between 44% and 51%, depending on the frame size of the cow,” Scholtz explains.

“One of the focuses of the ARC’s Animal Breeding Group is the presence of “broken genes” in beef cattle, which may impact on fertility. Broken genes refer to the phenomenon where genes from the bull and cow are not compatible and the fertilised egg does not develop or there is early embryonic death. The cow is then deemed to be low or even infertile. Yet, if she was mated to another bull, she may be perfectly fertile. If alleles and/or genes with a detrimental effect on female fertility in beef cattle can be detected, it will result in herd management that can increase fertility.”

“It is also important to investigate the use of alternative measures of fertility other than calving interval and days to calving. The same group at the ARC is looking at using the random regression approach, to estimate breeding values (EBVs) for “Expected number of calves for the cow at X years of age”. The relevant breeders’ society can decide what age “X” should be.”

Click here to learn more about other research at the ARC Irene.

6. Conservation agriculture

Dr Hendrik Smith, the conservation agriculture (CA) facilitator at Grain SA elaborates on new research on CA that aims to make integrated crop and livestock farming sustainable.

Current research focuses on the integration of livestock with existing CA systems as one of the most important principles and practices in a mixed production system to ensure economic and ecological sustainability. This will also allow producers to be more resilient. Key concepts of importance in CA systems are minimal soil disturbance, crop diversification (e.g.

crop rotation) and permanent organic soil cover, with crop residues or cover crops. These practices improve the biological, physical and chemical qualities of soil but can also be successfully applied to serve as animal feed. In fact, most crops used as cover crops or as part of a crop rotation system have been commonly used as animal feed, long before their benefits for improving soil health became known.

The research focuses on the testing of the integration of various grain and cover crops to improve the productivity of livestock farming. Important components include the use of ultra-high density grazing and the planting of suitable cover crops of high quality that accelerates animal growth and serves as valuable feed in the winter and early spring. An example of such cover crops is pulses or legumes. Trial tests are also done on other crops that provide winter feed such as types of radish, turnips, clover, oats and vetch. These crops are of significance since they are of higher nutritional value and quality than feed usually available during this time.

The research measures the following:

• Ecological indicators of the system, such as carbon sequestration, increased biodiversity, ecological regeneration and improved soil health.
• Economic indicators, which include biomass and meat production per hectare, profitability, efficiency of production inputs, labour and risk.
• Socio-cultural indicators such as food diversification, food security, demand and preferences of consumers.

Click here to watch a video of Grain SA's other projects that focus on conservation agriculture.

7. Wine

Winetech's Technology Transfer Coordinator for Viticulture, Lucinda Heyns says that it is predicted that the Western Cape's rainfall will decline by 30% by 2020. The responsible and effective management of water on wine farms and in cellars will not just become a necessity but will be the key to economic viability.

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25 Oct 2017

With this outlook in mind, Wine Industry Network for Expertise and Technology for the Wine Industry (Winetech) launched a number of research projects in 2018 that focus on water usage and management in the sector. See a summary of these below:

• One of these projects evaluates new wine grape cultivars for their drought resistance in South African conditions.
• Another trial compares different combinations of grafted rootstock and scion cultivars and their reaction to water stress.
• A research project in cooperation with the South African Water Research Commission (WRC) is aimed at developing a tool to assist producers to determine their water footprint. The goal of this tool is to enable producers to identify where in the production process the most water is used. This may indicate where they can focus on implementing water saving practices where it will have the biggest impact.

The knowledge gained from these research projects will equip the industry to make better long-term decisions that help to save water and improve water use efficiency.

8. Renewable energy

Nicole Algio, regional secretariat manager for REEEP, a partner of the South African National Energy Development Institute (SANEDI) shared her take on why research in renewable energy in agriculture should be one of the most

important research projects for 2018.

The agricultural sector, and especially the Southern African Development Community (SADC) region, is currently faced with unpredictable changes in food availability and low crop yields due to changes in weather and climate patterns with a visible shift in seasons and rainfall. Other factors impacting agricultural production levels are labour, water and energy-intensive agricultural methods. This has had a negative knock-on effect on local food prices, agricultural export, employment, social development and overall economic output.

The region also continues to face significant challenges in energy access, development and usage. Access and use of clean, alternative energy and opportunities for energy efficiency in the agricultural sector have not yet been fully explored in Southern Africa. These are critical in achieving sustainable energy in the agriculture sector and improving socio-economic activities. According to Algio, research and development are critical in ensuring that targeted action is taken to address energy and the water issue in agriculture to foster innovation, adapt to climate change and reduce socio-economic stress. Algio pointed out the following research themes that are critical to the sector:

• Understanding the full energy production potential in agricultural value chains
• Understanding the full energy consumption in agricultural value chains
• Understanding the full water consumption in agricultural value chains
• The energy-water nexus in agriculture
• Socio-economic impacts of energy and water consumption in agriculture
• Understanding the food-energy-water nexus and its impacts on sustainable agriculture
• Understanding clean energy systems for sustainable agriculture

REEEP and SANEDI are involved in several ongoing projects that bring renewable energy to farmers. Click here to read more about one of these projects called Switch Africa Green.

9. Wheat

In November 2017 the South African Cultivar and Technology Agency (SACTA) was launched to address the lack of cultivar development in the wheat and oilseed sectors. In the wheat industry specifically, research is being done to improve wheat cultivars. Dr Francois Koekemoer, director of research and development at Sensako said they are focusing on breeding wheat cultivars with increased yield. According to Koekemoer, it is a well-known fact that yield and quality (milling and baking quality) is negatively correlated.

Since the agricultural industry moved to a free-market trade system, an emphasis was given to develop wheat cultivars with acceptable milling and baking qualities as well as high yield. Thus, all new wheat cultivars' qualities are measured against a biological standard for an average of 21 characteristics which predict milling and baking qualities for commercial use.

Although South African breeders have succeeded in developing cultivars that is on par or even surpassed international standards, it has also led to increased importing of more affordable wheat of a poor quality. This flour is then mixed with high-quality local wheat which drives down the Safex price to below what the wheat is supposed to be worth. Following this, Sensako decided to keep high yielding cultivars in breeding programmes in the hope that this will provide information on how high the yield could be if there was no focus on breeding for certain qualities.

Although the process is a long one, it aims to include high-yielding wheat in breeding programmes to be evaluated despite not having accepted milling and baking quality as required by the processing industry. However, the current identified higher yielding varieties tend to show better milling and baking quality than that of the imported wheat. Click here for more information on wheat breeding.

10. Climate change

Wiltrud du Randt from the ARC's Grain Crops Institute shared information about research in progress to help the

agricultural industry and communities to adapt to climate change. Read more below:

“Climate change is expected to affect different communities in different ways depending on location, terrain, land use patterns, social networks, infrastructure, planning capacity, institutional, political and financial realities. These are relevant when communities/persons select their own adaptation measures.

To capture such complex biophysical and socio-economic heterogeneities, and to improve understanding of the impacts of climate change on agricultural outputs at a national and regional level in southern Africa, consistent methods and protocols are required. The agricultural model, “Intercomparison and Improvement Project” (AgMIP), has developed a range of climate, crop/livestock and economic modelling methodologies, protocols and tools to enable integrated climate change assessments. These tools and methodologies were tested by a multi-national and multi-institutional team of scientists under the lead of the ARC and the University of Cape Town.

A first phase study undertaken at household level in Namibia, Botswana and district level (Bethlehem) in South Africa was completed in 2015. In the second phase, that is just finishing completion, this study was up-scaled to cover the Free State. Whilst the first phase of the study looked at the impact of climate change under a “business as usual” scenario (moderate sustainable growth), the second phase of the study investigates the impact of climate change under two different futures that are associated with different representative agricultural pathways.

The first future scenario looked at an economic-environmental trade-off with sustainable low growth linked to a low emissions scenario, whilst the second scenario investigated economic-environmental trade-off with unsustainable high growth and fragmentation, linked to a high emissions scenario.

In addition, an adaptation strategy option was developed and tested under current and future climate. Inputs to develop these scenarios were solicited through stakeholder engagement workshops, previous research and interviews. The study linked climate-, crop- and socio-economic models through a geographic information system (GIS) in order to produce scalable information, which had never been done in previous assessments. In this study, it has become clear that, in order for stakeholders, policymakers or farmers to make informed and well thought through decisions, they require reliable evidence to support their decision process. The structure and methodology of this study allowed the researchers to link quantitative and qualitative evidence in a scientific process and to unpack the complex research questions.

Findings of the study will be made available to stakeholders and policymakers soon through a web-based portal (Impacts explorer) and publications. Theatre, as a medium of communication of climate change, developed through the project was well received by both the public and scientific communities as it is fun filled and understandable.”