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GAUTENG PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

The use of biologicals: The window to sustainable production for smallholder farmers

"Healthier plants with the help of Biologicals"

19 May 2020

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AgriFoSe2030
Agriculture for Food Security 2030
- Translating science into policy and practice

SLU
Sveriges lantbruksuniversitet
Swedish University of Agricultural Scienc

Farming and Food security

- **Farming in South Africa (SA)**
  - Less than 1.6 million citizens involved a form of farming (3% of population)
  - 30,000 commercial farmers (0.06% of the population)
    - Supply 80% of the food in South Africa
  - 162,000 formal rural farms (0.3% of the population)
    - Average farm size of 1400 ha)
  - SA contributes 24 times less to the count of global farmers
    - Estimated 26% of SA population lives in food insecure conditions

- **Smallholder farmers (SHFs)**
  - Current challenges in SA due to large scale industrialized conventional agricultural
    - Environmental degradation
    - Disturbed ecosystems
    - Loss of topsoil
    - Modern human sicknesses
    - Large CO_2 emissions
    - Sustainability of our food system for long-term food security?
      - Possible route to socially and ecologically just and intensified
      - agricultural systems by SHFs
      - Produce more food per hectare than large farms
      - Easing access - direct and has possibility to drive food prices down

Rationale: SHF support

- **Food sources for households**
  - Market, subsistence production, transfers from public programmes or other households
  - Market purchases: 90% of the food supplies
  - Food expenditures: 60-80% of the total household income
  - Food insecurity is more serious among urban poor – market dependency

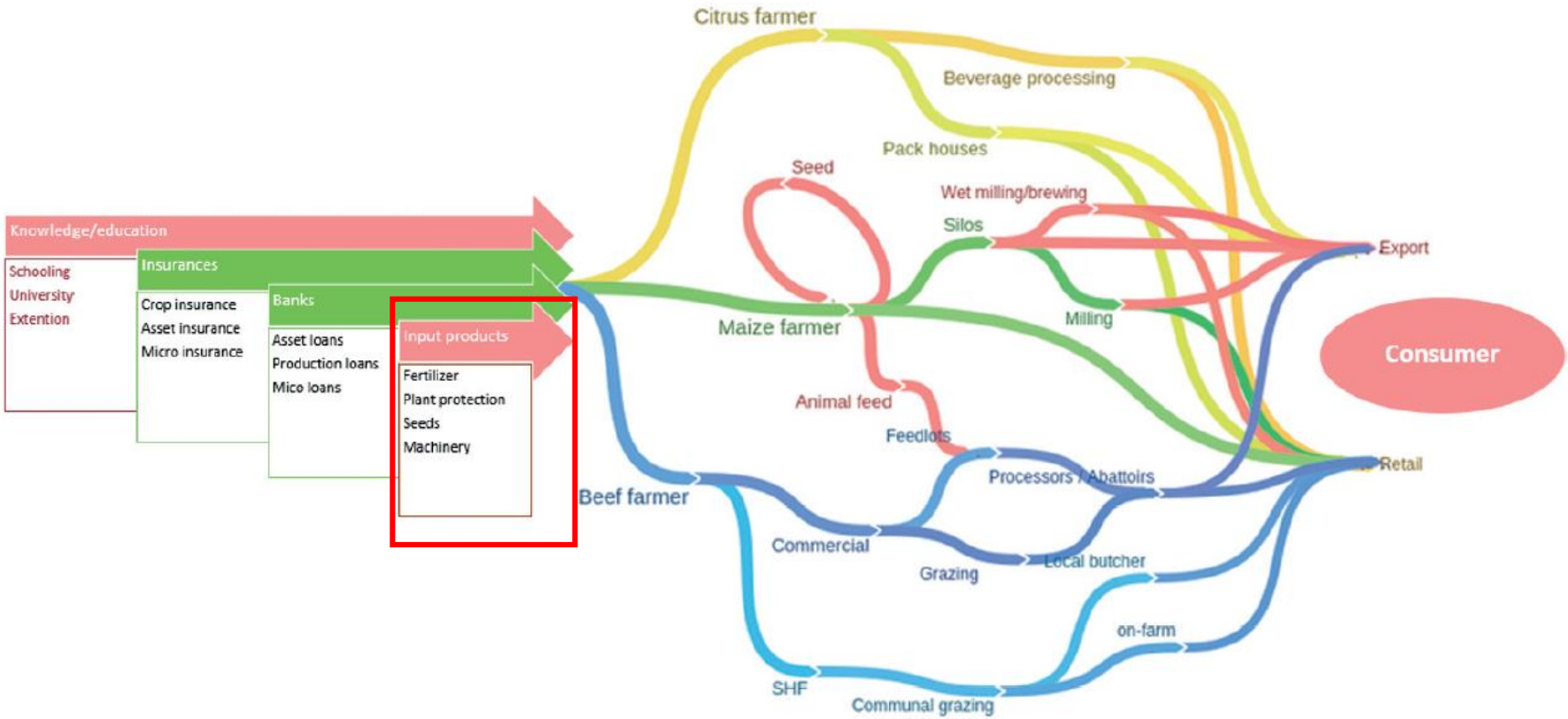
According to Lattimer (2013), innovation is a new approach that can generate learning for the stakeholders and has to bring positive results for the people

- Christiansen *et al*. (2011) and UNFCCC (2014) classified technologies into hardware, software, and orgware
  - In agricultural:

  Hardware - **different crop varieties**,
  Software - **farming practices** or **research on new farming varieties**,
  Orgware - **local institutions that support the use of agricultural adaptation technologies**



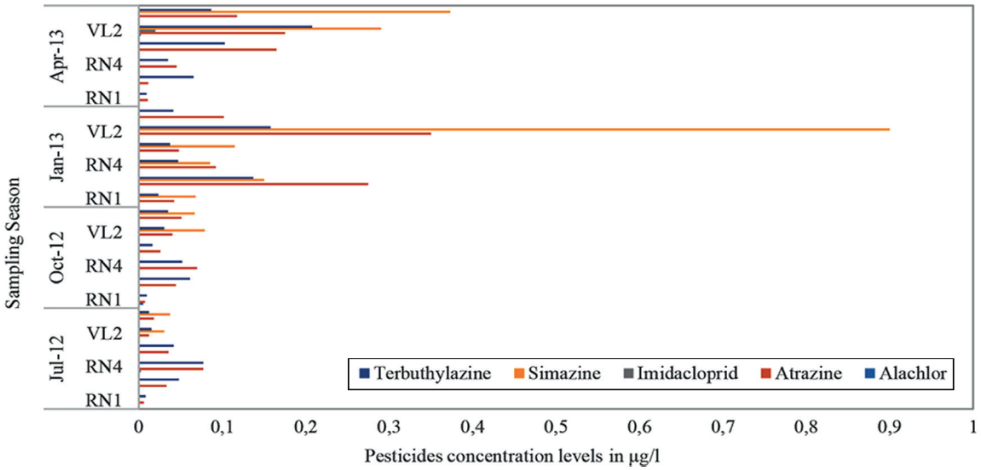
Rationale: SHF support



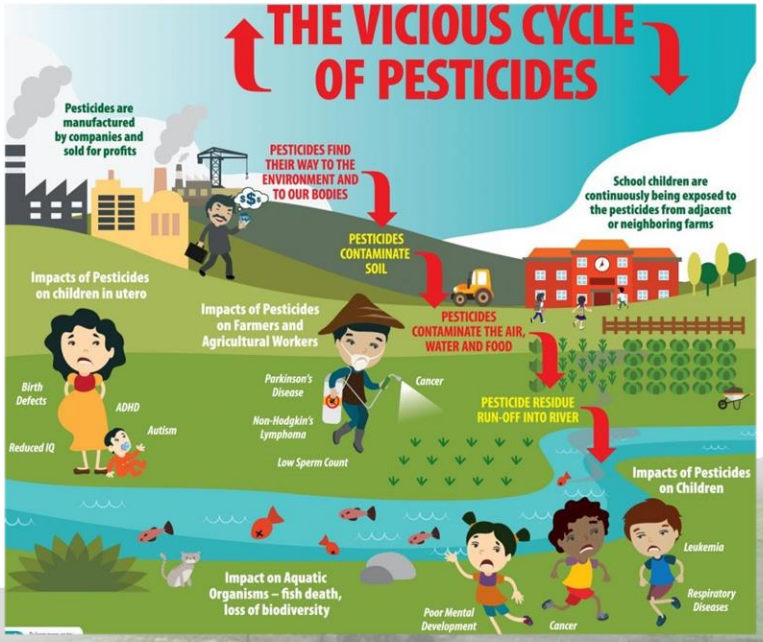
von Loeper *et al*., 2018 "*The Struggles of Smallholder Farmers: A Cause of Modern Agricultural Value Chains in South Africa*"

"Retailers said that they almost exclusively bought commercial volumes and that SHFs were ever only going to be a very small part of that supply."

Rationale: SHF support



Concentration levels (in µg/L) of detected pesticides in the Vals and Renoster catchments as detected in raw and tap water. Machete and Shadung, 2019



Current status of crop protection

- ❑ Rigorous use of agrochemicals
  - Meet food production and consumption gap.
  - Mitigate impact of climate change, ie, intensity of pests and diseases.
- ❑ Relatively high costs of agrochemicals.

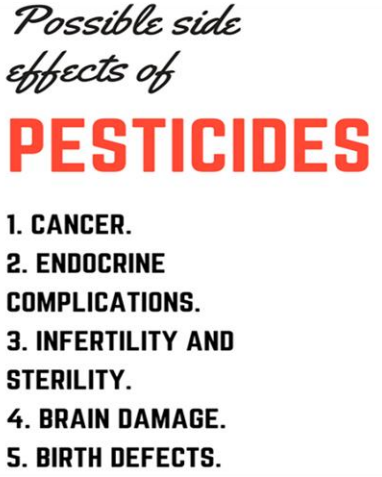
Application

- ❑ Spray equipment selection.
- ❑ Diversifying chemicals for effective control.
- ❑ Treatment timing.
- ❑ Chemical handling.
- ❑ Decontaminating equipment and PPE.
- ❑ Disposal of surplus spray.
- ❑ Disposal of empty chemical containers.

Rationale: SHF support

- Most SHF cannot afford agrochemicals
  - Experience significant loss in production.

- Some SHF use of agrochemicals without required PPE
  - Suffer from side effects of exposure to agrochemicals.



- Some SHF unable to diversify chemicals
  - Limited crop protection during production season.
  - May experience production and yield loss.

Botanical extracts may be the solution

Environmentally friendly, biodegradable, inexpensive, easy to prepare.

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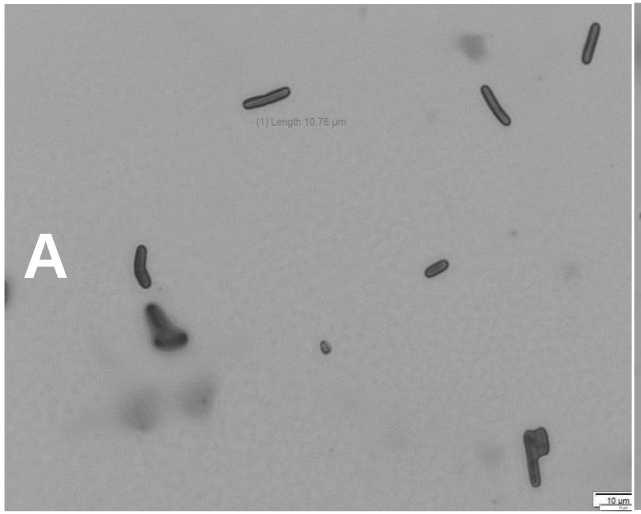
In vitro analysis of botanicals

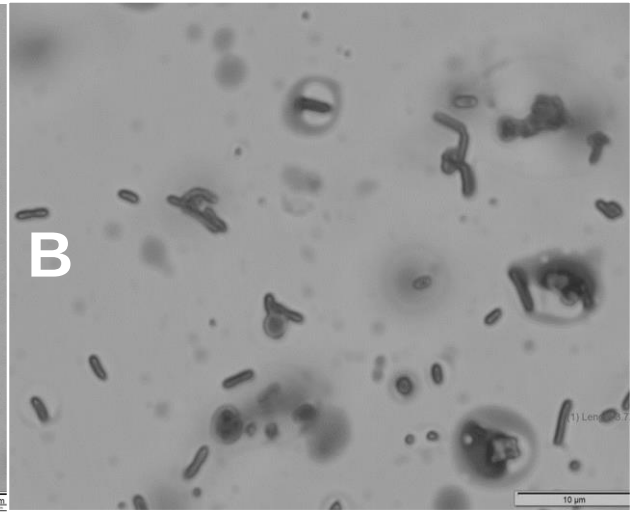
A B C

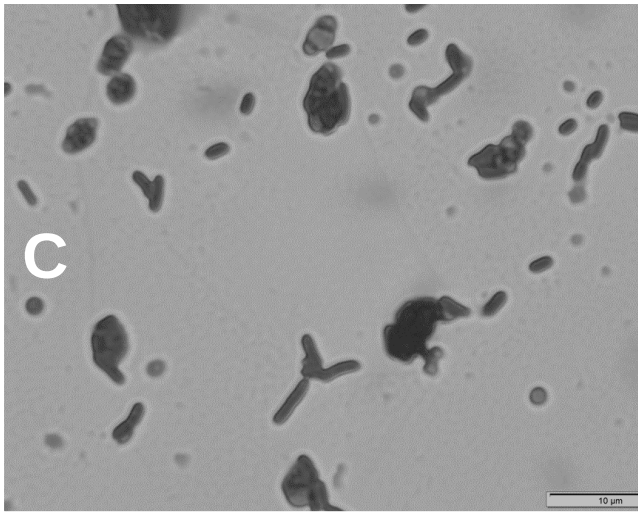
Evaluation of Lantana-based extracts as a bactericide against *Pseudomonas syringae* pv. *syringae*.

A: Bacteria streaked onto agar plates containing water as treatment; **B**: Bacteria streaked onto agar plates containing Lantana-based extracts; and **C**: Bacteria streaked onto agar plates containing Lantana-based extracts mixed with emulsifier.

In vitro analysis of botanicals

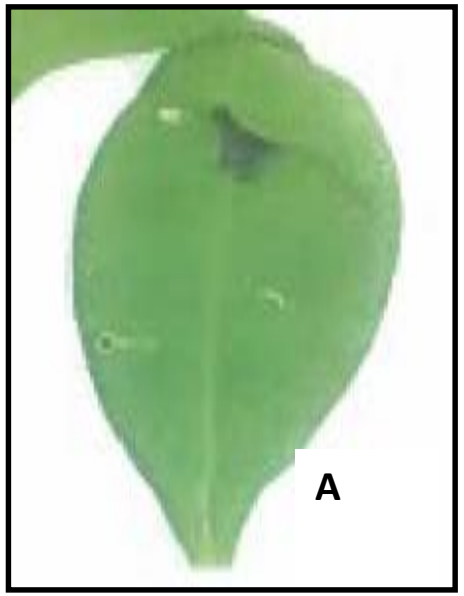


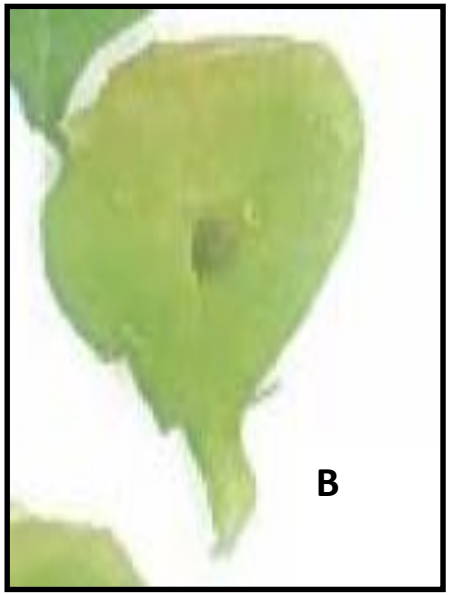


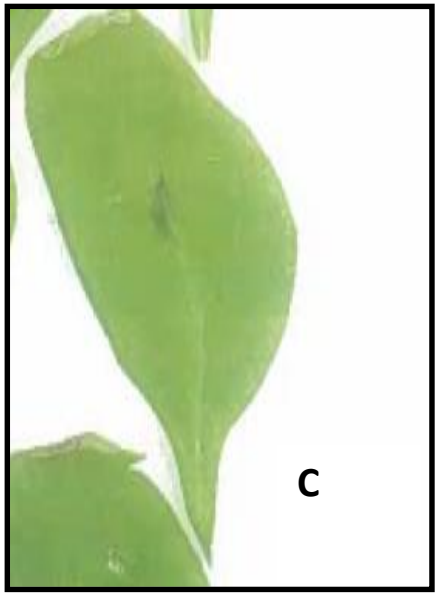


The effects of different concentrations of Lantana-based extracts on the morphology of *Burkholderia andropogonis* observed using a light microscope.
A: untreated control bacteria; **B**: bacteria treated with 0.156 mg/ml Lantana-based extracts; **C**: bacteria treated with 0.156 mg/ml Lantana-based extracts 1.25 mg/ml Lantana-based extracts.

In vitro analysis of botanicals







Analysis of the effectiveness of Lantana-based extracts in controlling *Pseudomonas syringae* pv. *syringae* on three week old baby spinach leaves.
A: Pricked baby spinach leaf, uninoculated; **B**: Pricked baby spinach leaf inoculated with *P. syringae* and treated with water as negative control; **C**: Pricked baby spinach leaf inoculated with **P. syringae** and sprayed with Lantana-based extracts.

Botanicals: Potato case study

	Production cost	Average
1	Seed	R 30 368
2	Fertilizer	R 16 032
3	Chemicals	R 14 721
4	Irrigation (water, energy, repairs & maintenance)	R 6 581
5	Land rent	R 9 375
6	Miscellaneous (telephone, auditor, insurance, levies, etc)	R 6 761
7	Management	R 1 667
8	Permanent labour	R 4 058
9	Seasonal labour	R 11 078
10	Fuel	R 3 621
11	Repairs & maintenance	R 4 672
12	Sorting & packaging	R 13 084
13	Transport to fresh produce markets	R 14 545
14	Market commission (authority & agents)	R 20 755
15	Interest on working capital	R 3 468
16	Capital recovery	R 11 656
17	Entrepreneurs' remuneration & capital expenses	R 7 750
Total production and marketing costs		**R 180 193**

Field trials results: Potato

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Disease: Late blight
Cause: *Phytophthora infestans*
Type: Fungi

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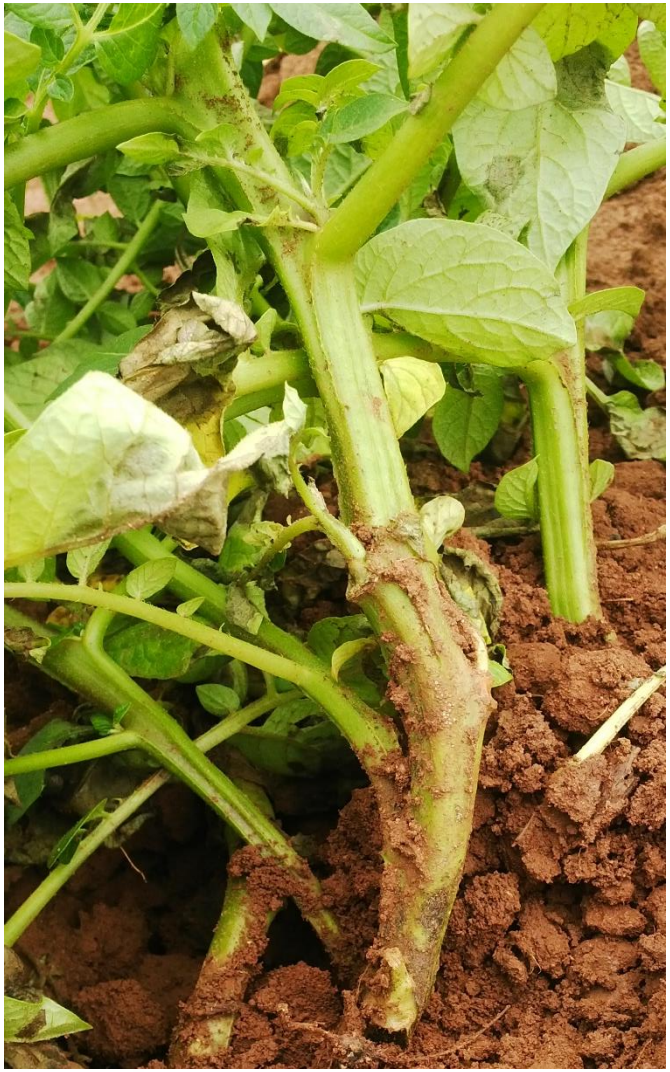
Cause: *Phytophthora infestans*
Type: Fungi

Disease: Brown leaf spots
Cause: *Alternaria alternata*
Type: Fungi

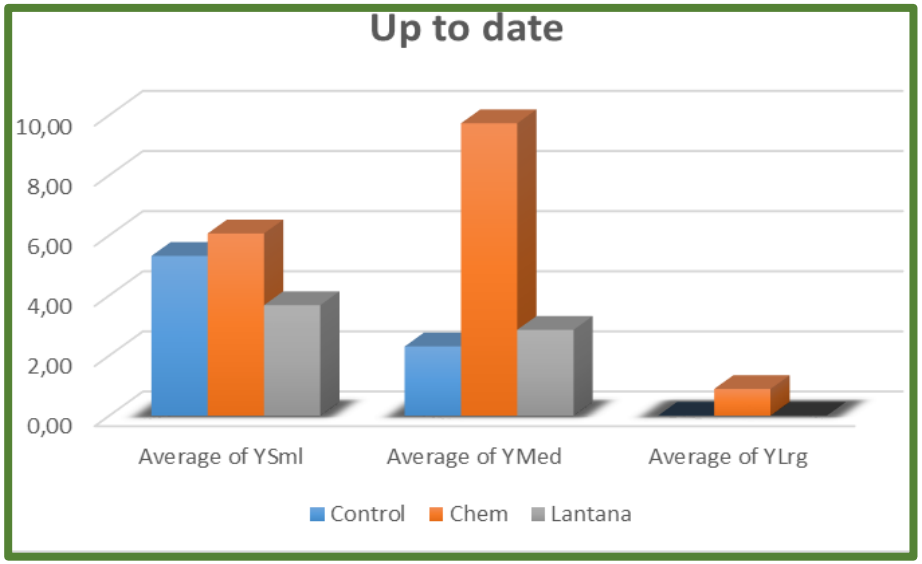
Field trials results: Potato



Disease: Blackleg
Cause: *Pectobacterium carotovorum*
Type: Bacteria

Disease: Early blight
Cause: *Alternaria solani*
Type: Fungi

Yield and quality

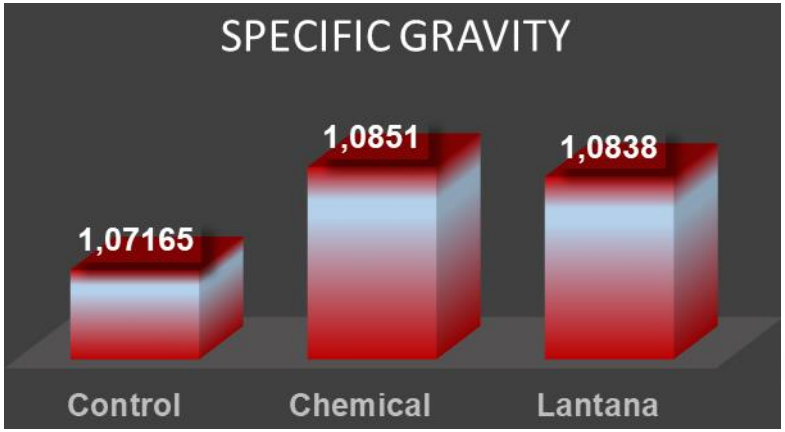


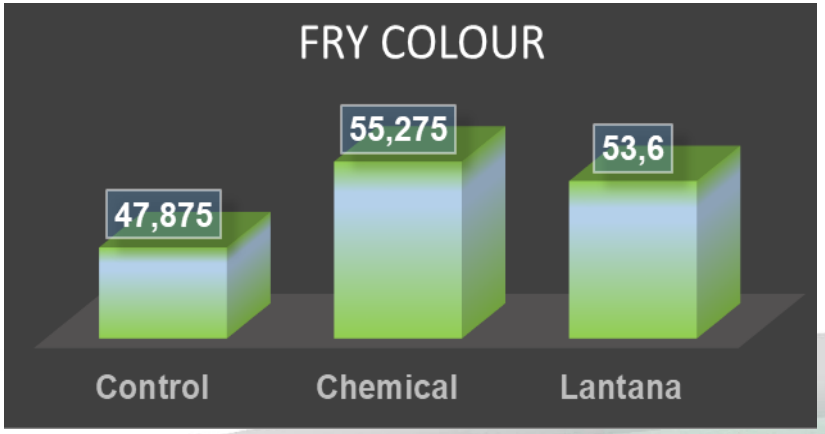
1. Specific gravity (SG) of potato

- ❑ Important for processing potatoes
- ❑ Higher dry matter = lower water content = higher SG
  - Acceptable SG – higher than 1.080
- ❑ Benefit
  - Chips/ Crisps are light in colour, crisp outside, fluffy inside, minimum oiliness

2. Fry colour

- ❖ Values above 50 = relatively lighter or brighter color





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Demonstration trial: AgriFoSe

Demonstration trial: AgriFoSe

No treatment

Lantana treatment

Lantana + Phosphite treatment

Outputs from botanicals

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RESEARCH ARTICLE

Botanicals and plant strengtheners for potato and tomato cultivation in Africa

Tewodros Mulugeta[1, 2], Jean-Baptiste Muhinyuza[3], Reinette Gouws-Meyer[4], Lerato Matsaunyane[5], Erik Andreasson[6], Erik Alexandersson[6]

Botanical and Plant Resistance Inducers (PRIs): Potential Alternatives to Pesticides in Potato and Tomato Cultivation in Africa

Key messages

- *Potato and tomato diseases and pests are causing a huge economic loss in Africa.*
- *Improper use and application of synthetic pesticides is affecting the health of smallholder farmers and the environment. The expected increased use of pesticide can aggravate the problem.*
- *There are alternatives crop protection agents including botanicals and plant resistance inducers, which can be more benign to farmers and the environment.*
- *A number of botanicals and Plant Resistance Inducers (PRIs) have been found effective in the management of tomato and potato pests and diseases also in dry and tropical climates.*
- *The prospect of the use of these alternative crop protection agents can be further strengthened through research activities, training of smallholder farmers, and through the involvement of advisors, policy makers and non-governmental organizations (NGOs).*

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Benefit analysis

1. Cost-Benefit (Potato)

Costs Structure per 0.005ha: Chemicals			
Item	Unit	Quantity	Costs (R.)
AgroChemicals	gram	700	832,00
Water	litres	210	0,21
Disposable coverall		1	3 360,00
Safety gumboots (non- steel toes)		1	100,00
Double respirator		1	1 900,00
Chemical Resistant gloves		1	700,00
Total			6 892,21

377,63 USD
3648,22 SEK

Costs Structure per 0.005ha: Lantana			
Item	Unit	Quantity	Costs (R.)
Leaves samples (harvest from wild)	kg		0
Drying leaves			0
Water	litre	216	0,216
Emulsifier (150ml per spray_)	litre	5	25,46
Treatment		14	0
Phosphite	litre	20	450
Total			475,68

26,06 USD
251,79 SEK

2. Safe and biodegradable

1. Toxicity test required
2. Half life test required

3. Easy to prepare and administer

1. Proven during project

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Future studies

- **South African Bioproduct Organisation (SABO)** (Established in 2013)
  - Collaboration between SA Dept of Agri, Universities and research institutions and bioproduct industry
  - Improve standards of bioproducts in the market to protect the market and the end users
  - Purpose - develop the bioproduct industry in South Africa and regulate the activities of participants

- **Products**

1. Biocontrol Agents
   - Use of living organisms to control pest populations
     - Parasitoids
     - Predators
     - Plant extracts
     - Microbial extracts
     - Pheromones

2. Biostimulants
   - Products that stimulate natural processes in the plant to enhance nutrient uptake, nutrient efficiency, increased tolerance to abiotic stress, and crop quality, vigour and yield
     - Microbial inoculants – bacteria, fungi or other organisms
     - Plant extracts – an extract of plant material
     - Microbial extracts – an extract from microbial growth media

Future studies

- More research needed
  - Increased concentration of botanical extracts
  - Induced resistance monitoring
  - Toxicity tests ….comply with requirements

- Challenges
  - Funds
    - Research
    - Equipment
    - Manpower
  - Collaborations- research & industry
  - Resistance on possible replanting of weeds

Thank you

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