

PRODUCTION GUIDELINE FOR AFRICAN LEAFY VEGETABLE CULTIVATION IN THE CAPRICORN AND VHEMBE DISTRICT IN LIMPOPO

Hintsa Araya, Salmina Mokgehle, Christian du Plooy, Stephen Amoo, Mariette Truter, Khomotso Maboka and Manaka Makgato



**WATER
RESEARCH
COMMISSION**

TT 914/23



PRODUCTION GUIDELINE FOR AFRICAN LEAFY VEGETABLE CULTIVATION IN THE CAPRICORN AND VHEMBE DISTRICTS IN LIMPOPO

Report to the
Water Research Commission of South Africa

edited by

**Hintsa Araya, Salmina Mokgehle, Christian du Plooy, Stephen Amoo,
Mariette Truter, Khomotso Maboka and Manaka Makgato**

Agricultural Research Council – Vegetables, Industrial and Medicinal Plants,
Roodeplaat, Pretoria, South Africa



WRC Report No. TT 914/23

ISBN 978-0-6392-0402-4

May 2023



Obtainable from

Water Research Commission
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Lynnwood Bridge Office Park
4 Daventry Road
Lynnwood Manor
PRETORIA

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This is the final report for project no. C2021/2022-00247

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EXECUTIVE SUMMARY

This guideline was made possible by the Water Research Commission (WRC) under project number C2021/2022-00247, in collaboration with the Agricultural Research Council on adopting *small-scale irrigation farming as a climate-smart agriculture practice through vegetable production systems in Limpopo.* This guideline focuses on the practical application of problem-solving strategies in agricultural practices for smallholder farmers in the Capricorn and Vhembe district in Limpopo. This included on-farm activities in informal training talks on seedling production, irrigation installations and utilization of chameleon irrigation sensors. This included discussions and demonstrations on the principles, processes and methods, and other aspects of mulching. During the regular monitoring visits, smallholder farmers were assisted in planting and applying fertilizers on their farm plots. This guideline summarises progress in human capacity development through school engagement and on-site training to transfer skills to the communities. This guideline argues that accelerating technology transfer to a farming community, including cultivation of indigenous or indigenized crops, climate-smart technologies are a viable option and that provided resources (e.g. agricultural inputs) can increase agricultural production.

ACKNOWLEDGEMENTS

The authors acknowledge the following institutions and persons who made various inputs to the successful coordination and running of the project activities over the period 2020-2023. These are:

Funding:

Water Research Commission of South Africa.

ARC-VIMP for contributions in kind in terms of technical support.

Governance and collaboration:

Members of the Reference Group for their constructive discussions and guidance during Reference Group Meetings.

Dr L Nhamo (Chairperson)	Water Research Commission
Prof. S Mpandeli	Water Research Commission
Prof. A Modi	University of Kwazulu-Natal
Dr SN Hlophe-Sinindza	Water Research Commission
Prof. C Mutengwa	University of Fort Hare
Dr B Petja	Water Research Commission
Prof. M van der Laan	Agricultural Research Council
Dr KA Tshikolomo	Limpopo Department of Agriculture and Rural Development
Prof. E Nesamvuni	University of Free State
Ms Sandra Fritz	Water Research Commission (Committee Secretary)

All project team members for their interest, dedication, and effort in editing the deliverables and the final report:

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Mr K Maboka	ARC-Vegetable, Industrial and Medicinal Plants
Dr M Nyathi	ARC-Vegetable, Industrial and Medicinal Plants
Ms B Serote	Tshwane University of Technology
Ms K Mashiane	Tshwane University of Technology
Mr T Mawela	Tshwane University of Technology
Mr A Matidze	University of Venda

Community members (Ms S Masethe, Ms A Mudau and Mrs R Kale) are acknowledged for their contribution to the projects and willingness to adopt technologies that have improved their livelihoods. **All the students** for their dedication and perseverance. Prof. JBO Ogola (University of Venda), Prof. P Soundy and Dr G Senyolo (Tshwane University of Technology) for their guidance and supervision of the **postgraduate students**.

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CHAPTER 1

INTRODUCTION

1.1 Background

Agriculture continues to contribute to rural economies in sub-Saharan Africa, with the majority of the population (60 to 80%) employed in agriculture and producing 15 to 50% of the Gross Domestic Product (GDP), as reported by Raidimi and Kabitani (2019) and the Organisation for Economic Co-operation Development (OECD), (2016). South Africa's agriculture is vital for economic growth, food security, and poverty reduction by supporting smallholder farmers. Smallholder farmers are essential drivers of the agriculture sector as they grow most food. Despite being endowed with limited resources to produce crops to combat food insecurity. Previous reports showed that establishing household food security is widely encouraged to advance the living standard of poor rural households (Ngema et al., 2018). One avenue towards realising the potential of smallholder farmers in agriculture can be fostered through appropriate agricultural extension, education and training (Ngema et al., 2018). The training can incorporate on-farm demonstrations as practical education to facilitate effective learning situations for farmers to experience practical adoption and diffusion of innovations. The training can also include the farmer to farmer learning involving participants learning from and with each other through informal and formal learning.

Training through demonstrations can include practical knowledge and activities such as field day events to monitor farms to allow the researchers, extension officers and industry members. This can assist with demonstrating innovative technologies and approaches. Given this variety, there is no 'one-fits-all' approach for successfully training smallholder farmers on various aspects of agriculture. This guideline offers an overview of the essential elements to consider when conducting farm-based training to enhance climate-smart technologies to inspire smallholder farmers' adoption of new practices in the Vhembe and Capricorn districts. The study outlines the on-farm training for smallholder farmers on different aspects of African leafy vegetable production in two districts in Limpopo province.

CHAPTER 2

TRAINING ON AFRICAN LEAFY VEGETABLE PRODUCTION IN THE TWO DISTRICTS OF LIMPOPO PROVINCE

2.1 Introduction

Agricultural training interventions are critical in facilitating knowledge transfer and agricultural skills to benefit smallholder farmers. Training interventions for smallholder farmers vary substantially, considering the theory and practical methods that can potentially adopt new technology and interventions to benefit communities. Such training interventions can contribute to the smallholder farmer's economic and food security outcomes. In this report, the smallholder farmers in the Vhembe and Capricorn districts were trained on different vegetable production training offered by the ARC team.

The on-farm trials and smallholder farmers' training on climate-smart agriculture technologies occurred in Limpopo's Vhembe and Capricorn districts. Ms Awelani Mudau is located in the Vhembe district in the Collins Chabane municipality in Hatshikonelo (22.8805° S, 30.7379° E). Ms Masethe Shonisani is located at 22°41'31" S 30°37'56" E in the Thulamela municipality in the Vhembe district. Ms Raesetsa Kale (24.4048° S, 29.3802° E) and Ratanang cooperative (-23.855362, 29.711946) are located in the Capricorn district under the Lepelle-Nkumpi and Polokwane municipality, respectively.

The training also included a basic understanding of climate-smart technologies, encompassing the theory and practical aspects. Developing knowledge and skills among farmers is one of the primary functions of agricultural extension. Therefore, the training provided by the ARC team in collaboration with the local extension officers in the two districts can contribute to increased productivity and maintain food security at a household level for smallholder farmers. Therefore, this chapter will report different production guidelines for African leafy vegetables for smallholder farmers in the Vhembe and Capricorn districts.

2.2 Production guideline for African leafy vegetables

2.2.1 Soil preparation

As part of training the smallholder farmers, soil preparation included a sampling of soils to understand the site's suitability for African leafy vegetable production. Figure 2.1 and Appendix A give step-by-step training that the smallholder farmers in the Vhembe and Capricorn districts received on taking soil sampling and information about the laboratories that assist with soil testing. As part of the practical training, the smallholder farmers also demonstrated some equipment that plays a role in soil sampling. This included a soil auger and spade; clean plastic and box items are essential. Soil preparation also includes working the soil deep with a fork to allow a workable seedbed for planting.

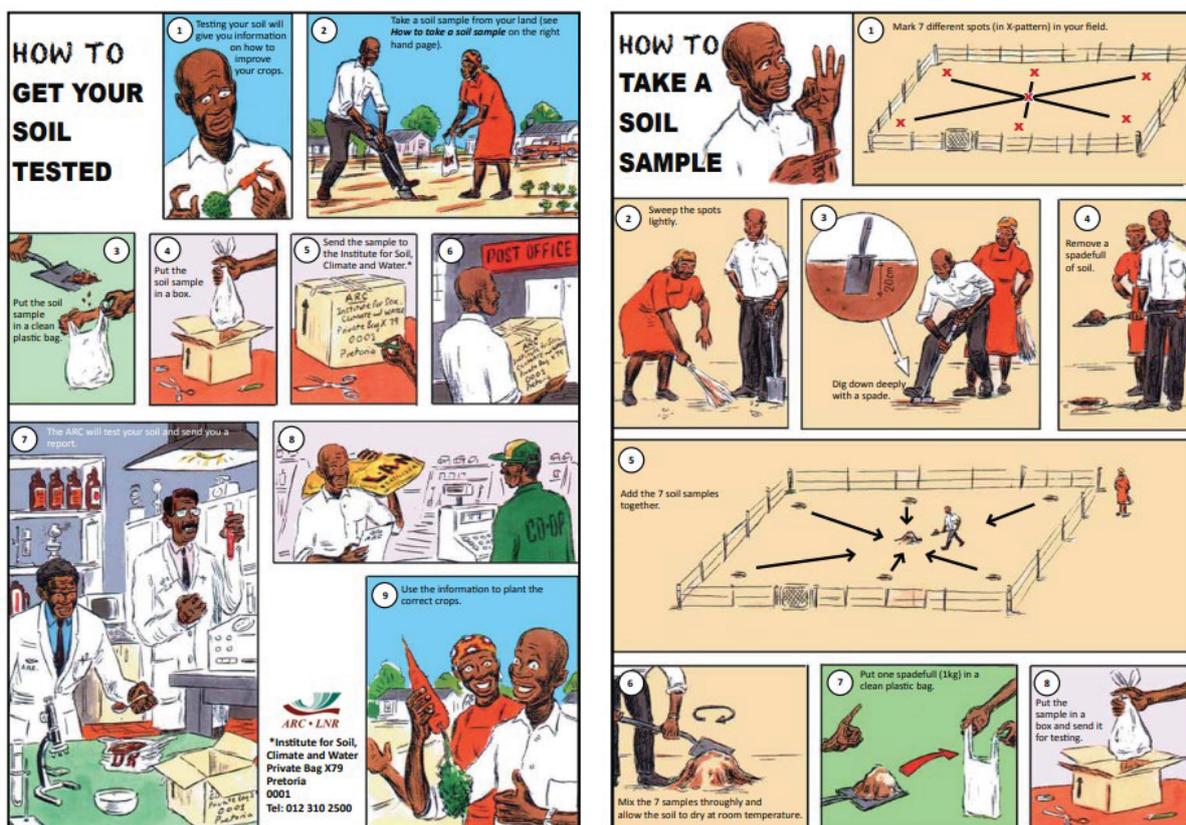


Figure 2.1: Step-by-step process of taking a soil sample and getting it tested in the laboratory.

2.2.2 Seedling production

Good quality vegetable seedlings are essential for improving yields and getting quality produce. The training of smallholder farmers provided step-by-step approaches to growing good-quality seedlings. As stipulated in Figure 2.2 and Appendix B, some materials required to produce good quality seedlings include seedling trays, growing medium, certified seeds and watering. In the Capricorn district at Kale's farm (see Figure 2.3), the smallholder farmers were trained to keep the seedling trays clean before as part of the preparations. The practical training included moistening the growth medium and putting it on the seedling trays to prepare for seed sowing. The smallholder farmers were trained to sow the seeds in each hole of the seedling trays (Figure 2.3). The guideline presented in Figure 2.2 also guides the smallholder farmers on thinning seedlings in cases where two or more seeds were sown.

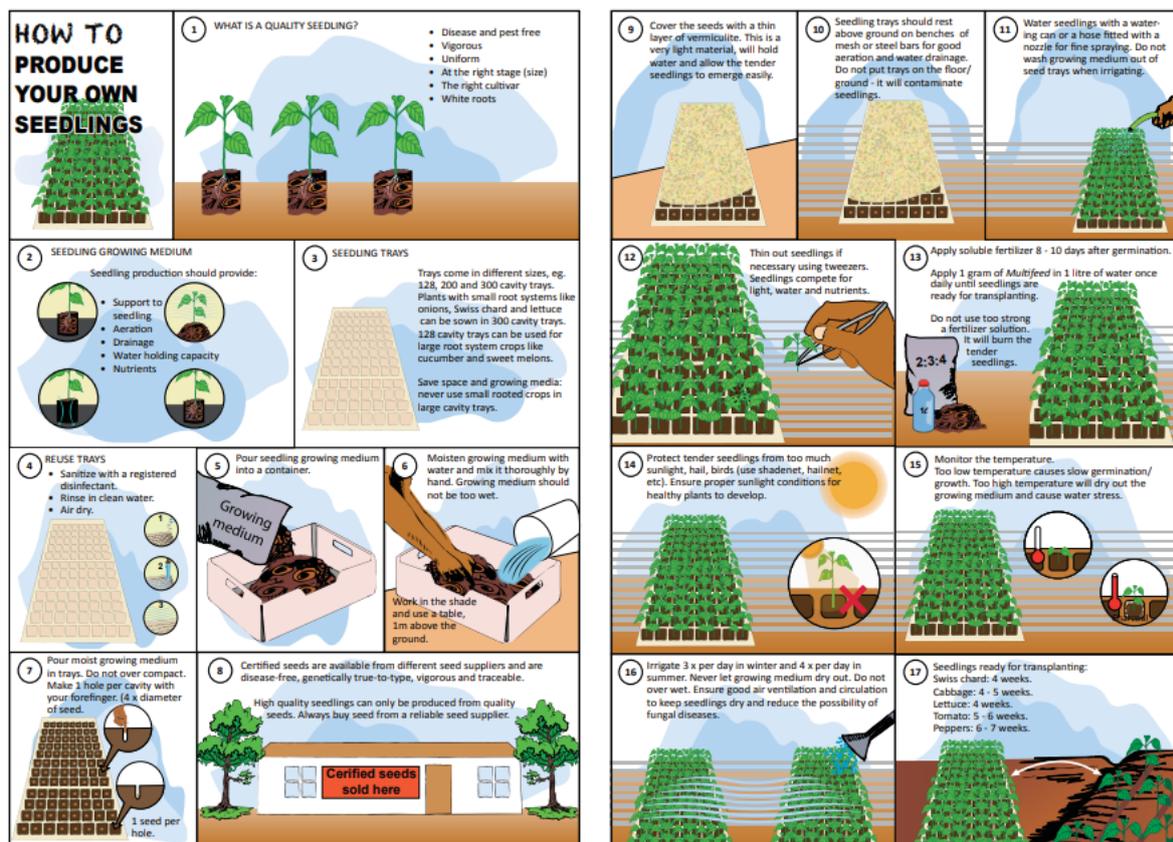


Figure 2.2: Step-by-step process of producing seedlings.



Figure 2.3: Training smallholder farmers in the Capricorn district on seedling production.

2.2.3 Cultivation

African leafy vegetables can be cultivated in different forms (Appendix C). For example, vegetable crop seeds can be sown directly into the field to grow (Figure 2.4). Smallholder farmers can use the transplanting method requiring good-quality seedlings (Figure 2.4). The African leafy vegetables such as Okra, cowpea and Bambara groundnut are cultivated from August to November for direct sowing and transplanting (Figure 2.4). The smallholder farmers in the Vhembe and Capricorn districts were trained to cultivate vegetable crops. Figure 2.5 shows the smallholder farmers in the Vhembe (A) and Capricorn (B) districts transplanting vegetable crops.

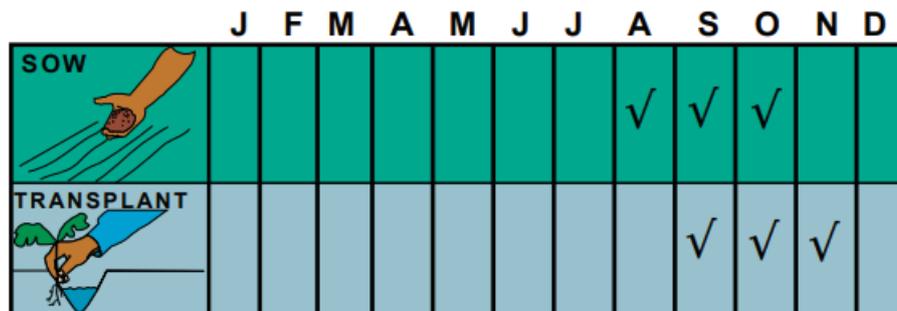


Figure 2.4: Training smallholder farmers in the Capricorn district on seedling production



Figure 2.5: Training smallholder farmers in the Vhembe (A) and Capricorn (B) on cultivating vegetable crops.

2.2.4 Fertilisation

The smallholder farmers received training on fertilizers and their application methods (Figure 2.6 and Appendix D) below. Fertilization is supplementing the existing soil with additional nutrients such as nitrogen, phosphorus, and potassium vital because they are essential for the growth and development of plants. Figure 2.6 indicates fertiliser application methods, such as the complete hand application of organic fertilizers and kraal manure through broadcasting. During the training, the smallholder farmer in the Capricorn district indicated that application is achieved through broadcasting and working the fertilizer into the soil with a small fork (Figure 2.6).



Figure 2.6: Training smallholder farmers in the Capricorn (B) on fertilizer application.

2.2.5 Mulching

The smallholder farmers were trained on the different mulches, which serve as a blanket to the soil to conserve moisture, enhance the nutrient status of soil, control the erosion losses and suppress the weeds in crop plants. During the training, the smallholder farmers resonated with the seedless grass mulch they adopted as part of climate-smart practices (Figure 2.7 and Appendix E). The smallholder farmer in the Vhembe district incorporates mulch with the soil to realize the benefits, while in the Capricorn district, mustard spinach is mulched with grass (Figure 2.7).



Figure 2.7: Training smallholder farmers in the Vhembe (A) and Capricorn (B) on mulching.

2.2.6 Irrigation system maintenance and scheduling

The smallholder farmers were trained in basic irrigation installation and management techniques. The smallholder farmers were trained on different irrigation techniques, such as drip and simple irrigation, using watering cans for seedling irrigation purposes. As part of the climate-smart practices, the smallholder farmers in the Vhembe and Capricorn districts were trained to utilise the chameleon moisture sensor (Figure 2.8) as a smart invention that helps farmers decide when to irrigate their crops, improving food production.



Figure 2.8: Training smallholder farmers in the Vhembe (A) and Capricorn (B) irrigation and chameleon sensors.

2.2.7 Harvesting

Smallholder farmers were trained and equipped with the skills to harvest different vegetable crops. Figure 2.9 indicate that smallholder farmers were guided to harvest the vegetable crops after four weeks of transplanting. For example, the smallholder farmers were shown to get multiple harvests from different vegetables (e.g. Swiss chard). The smallholder farmers were equipped with the skills of harvesting early in the morning or late in the afternoon when it was cool and postharvest handling (Appendix F). Some of the vegetable harvested from farmer's field in the Capricorn district is shown in Figure 2.9.

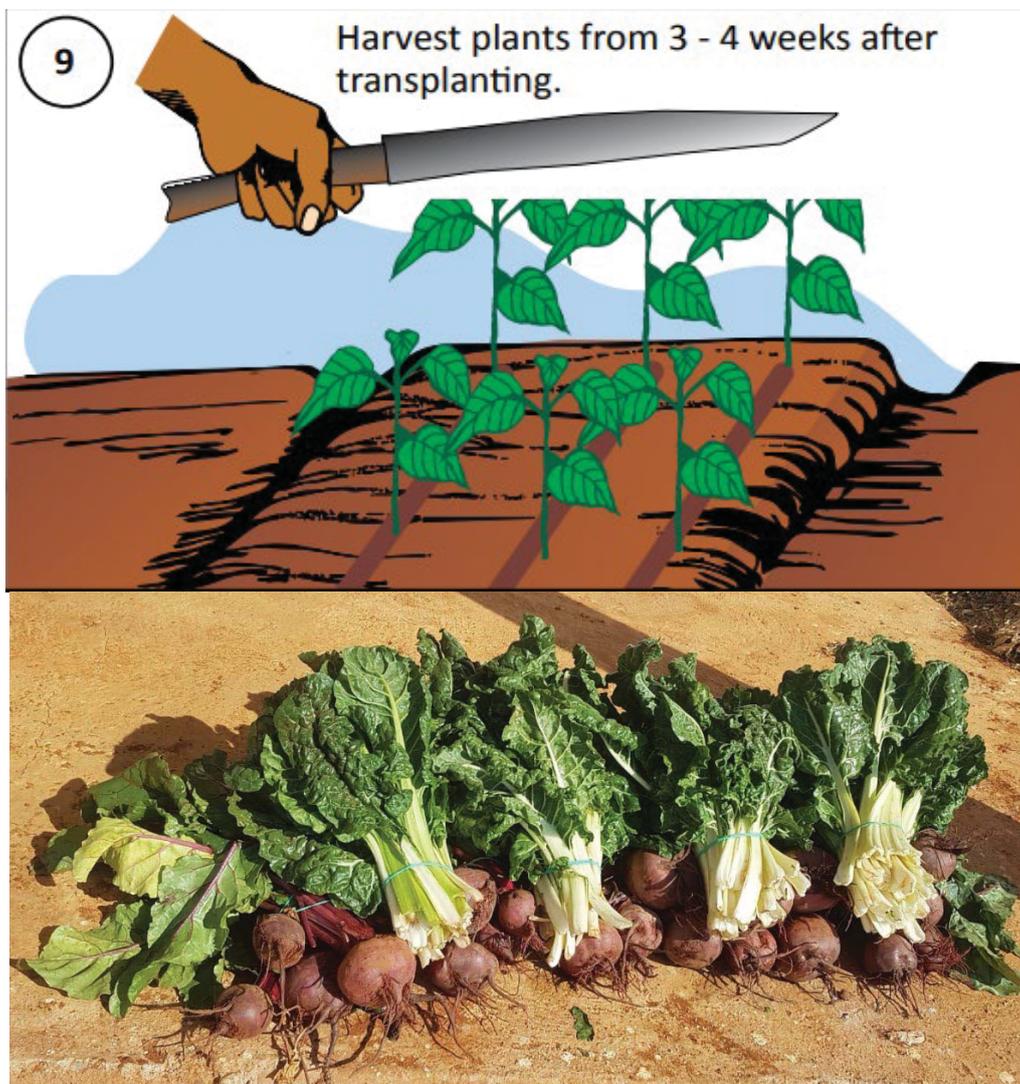


Figure 2.9: Training smallholder farmers in the Vhembe (A) and Capricorn (B) on harvesting.

2.3 Conclusion

This guideline has demonstrated several activities that smallholder farmers were trained on using the on-farm practical approach, which creates opportunities for smallholder farmers. The training based on the on-farm practical activities is essential in enhancing smallholder farmers in adopting climate-smart technologies.

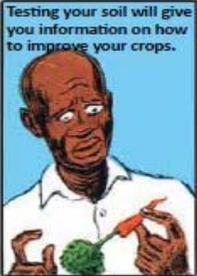
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- Raidimi, E.N. and Kabit, H.M. 2019. A review of the role of agricultural extension and training in achieving sustainable food security: a case of South Africa. *South African Journal of Agricultural Extension*, pp.120-130.

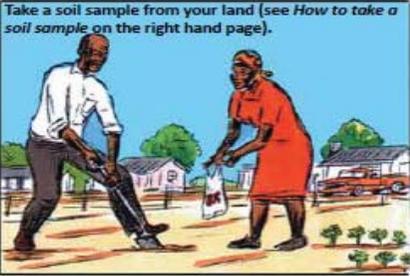
Appendix A: How to get your soil tested

HOW TO GET YOUR SOIL TESTED

Testing your soil will give you information on how to improve your crops.



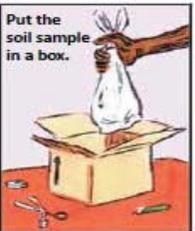
Take a soil sample from your land (see *How to take a soil sample* on the right hand page).



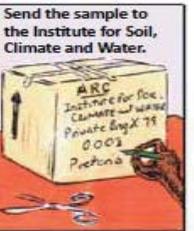
Put the soil sample in a clean plastic bag.



Put the soil sample in a box.



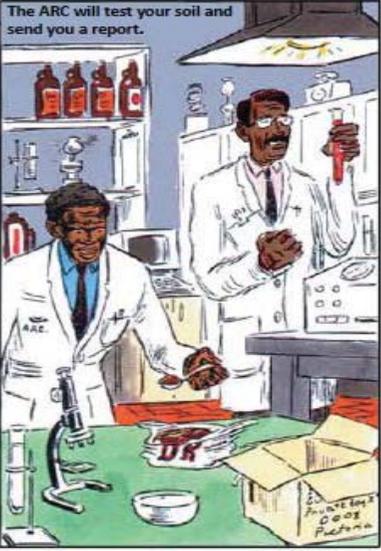
Send the sample to the Institute for Soil, Climate and Water.



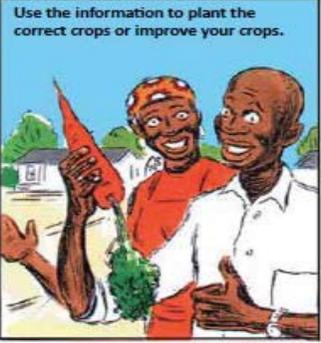
POST OFFICE



The ARC will test your soil and send you a report.

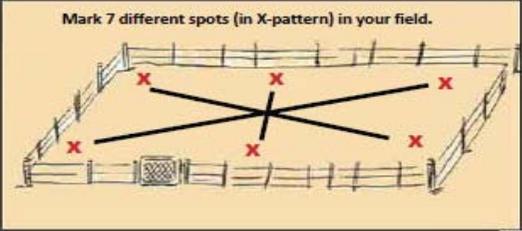


Use the information to plant the correct crops or improve your crops.



HOW TO TAKE A SOIL SAMPLE

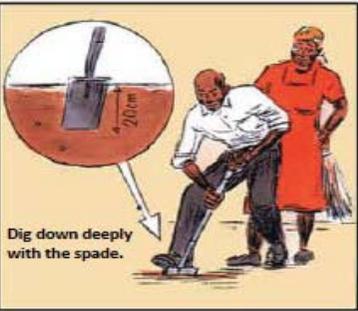
Mark 7 different spots (in X-pattern) in your field.



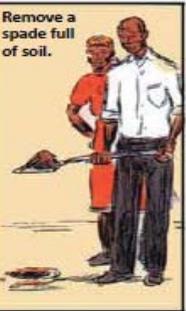
Sweep the spots lightly.



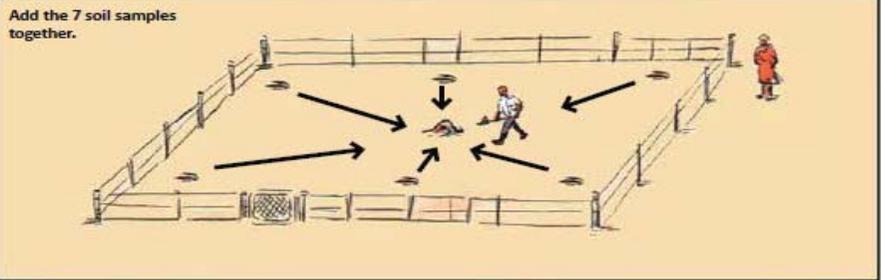
Dig down deeply with the spade.



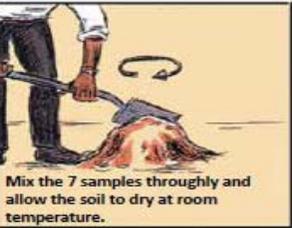
Remove a spade full of soil.



Add the 7 soil samples together.



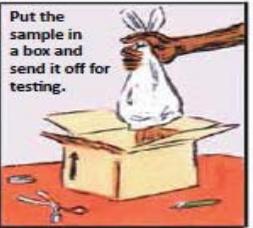
Mix the 7 samples thoroughly and allow the soil to dry at room temperature.



Put one spadeful (1kg) in a clean plastic bag.



Put the sample in a box and send it off for testing.



Appendix B: How to produce your own Seedlings

HOW TO PRODUCE YOUR OWN SEEDLINGS



1 WHAT IS A QUALITY SEEDLING?

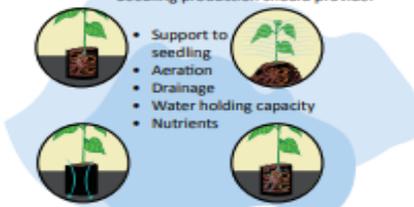
- Disease and pest free
- Vigorous
- Uniform
- At the right stage (size)
- The right cultivar
- White roots



2 SEEDLING GROWING MEDIUM

Seedling production should provide:

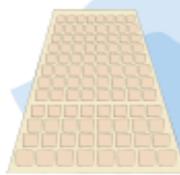
- Support to seedling
- Aeration
- Drainage
- Water holding capacity
- Nutrients



3 SEEDLING TRAYS

Trays come in different sizes, eg. 128, 200 and 300 cavity trays. Plants with small root systems like onions, Swiss chard and lettuce can be sown in 300 cavity trays. 128 cavity trays can be used for large root system crops like cucumber and sweet melons.

Save space and growing media: never use small rooted crops in large cavity trays.

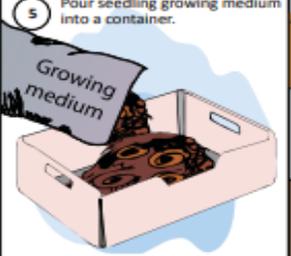


4 REUSE TRAYS

- Sanitize with a registered disinfectant.
- Rinse in clean water.
- Air dry.

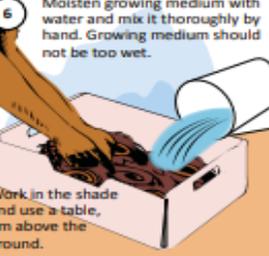


5 Pour seedling growing medium into a container.

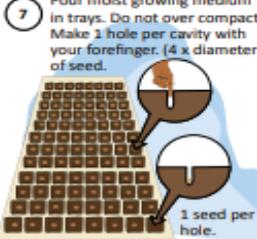


6 Moisten growing medium with water and mix it thoroughly by hand. Growing medium should not be too wet.

Work in the shade and use a table, 1m above the ground.



7 Pour moist growing medium in trays. Do not over compact. Make 1 hole per cavity with your forefinger. (4 x diameter of seed).



8 Certified seeds are available from different seed suppliers and are disease-free, genetically true-to-type, vigorous and traceable.

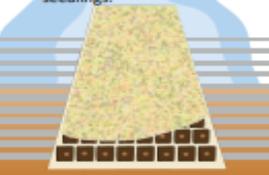
High quality seedlings can only be produced from quality seeds. Always buy seed from a reliable seed supplier.



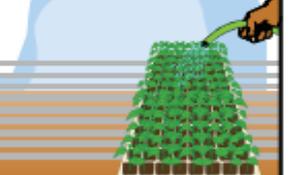
9 Cover the seeds with a thin layer of vermiculite. This is a very light material, will hold water and allow the tender seedlings to emerge easily.



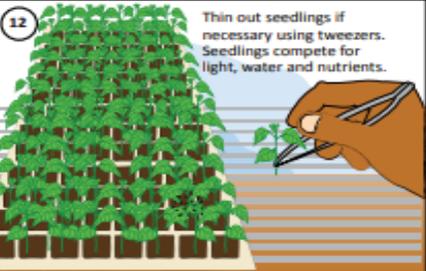
10 Seedling trays should rest above ground on benches of mesh or steel bars for good aeration and water drainage. Do not put trays on the floor/ground - it will contaminate seedlings.



11 Water seedlings with a watering can or a hose fitted with a nozzle for fine spraying. Do not wash growing medium out of seed trays when irrigating.



12 Thin out seedlings if necessary using tweezers. Seedlings compete for light, water and nutrients.



13 Apply soluble fertilizer 8 - 10 days after germination.

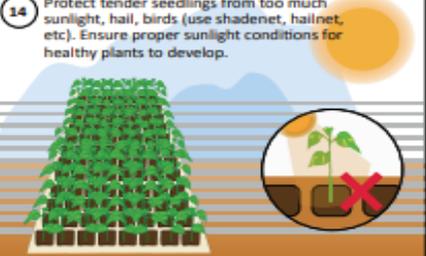
Apply 1 gram of Multifeed in 1 litre of water once daily until seedlings are ready for transplanting.

Do not use too strong a fertilizer solution. It will burn the tender seedlings.

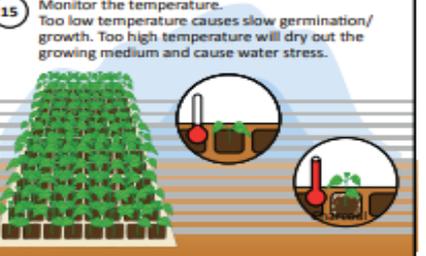
2:3:4



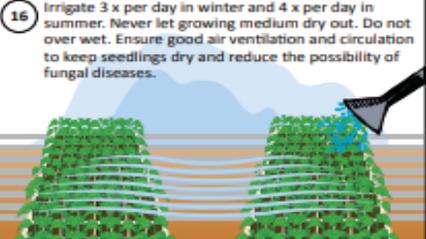
14 Protect tender seedlings from too much sunlight, hail, birds (use shadenet, hailnet, etc). Ensure proper sunlight conditions for healthy plants to develop.



15 Monitor the temperature. Too low temperature causes slow germination/growth. Too high temperature will dry out the growing medium and cause water stress.



16 Irrigate 3 x per day in winter and 4 x per day in summer. Never let growing medium dry out. Do not over wet. Ensure good air ventilation and circulation to keep seedlings dry and reduce the possibility of fungal diseases.



17 Seedlings ready for transplanting:

- Swiss chard: 4 weeks.
- Cabbage: 4 - 5 weeks.
- Lettuce: 4 weeks.
- Tomato: 5 - 6 weeks.
- Peppers: 6 - 7 weeks.



Appendix C: Let's Grow African Leafy Vegetables

LET'S GROW AFRICAN LEAFY VEGETABLES



	J	F	M	A	M	J	J	A	S	O	N	D
SOW									✓	✓	✓	
TRANSPLANT									✓	✓	✓	
HARVEST	✓	✓	✓						✓	✓	✓	✓

- 1 Soil preparation: work soil deep with a fork.
- 2 Fertilizer: one big hand/1 m² or OR Kraal manure: four big hands full/ 1 m². Work the fertilizer/manure into the soil with a fork.
- 3 Apply fertilizer / manure broadly over the area.
- 4 Rake fine. Remove large clods and stones.
- 5 Prepare the seedbed. 1 m wide, ± 1 fork length.

- 6 Space the seedlings 20 - 25 cm apart (two hand widths), in rows. Space the rows as indicated below.

15cm
30cm
30cm
15cm
- 7 Water regularly. Week 1 - twice a day, Week 2 - once a day, Week 3 and on - three times a week.
- 8 Harvest plants from 3 - 4 weeks after transplanting.
- 9 Apply top dressing after every harvest (i.e. LAN). Work the top dressing into the soil.
- 10 Scout regularly for pests and diseases. Combat pests and diseases.



Moth of Hawaii beetle webworm (12mm)



Aphids (1mm)



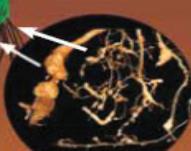
Lesser army worm (2.5mm)



Stem borer (25mm)



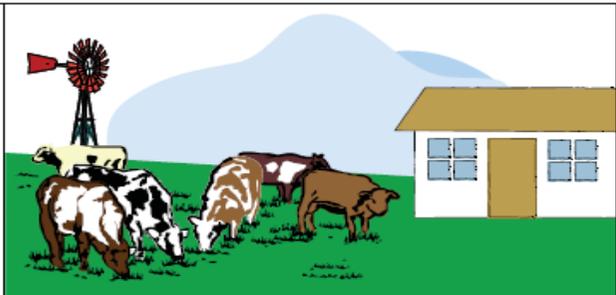
Cutworm (30mm)



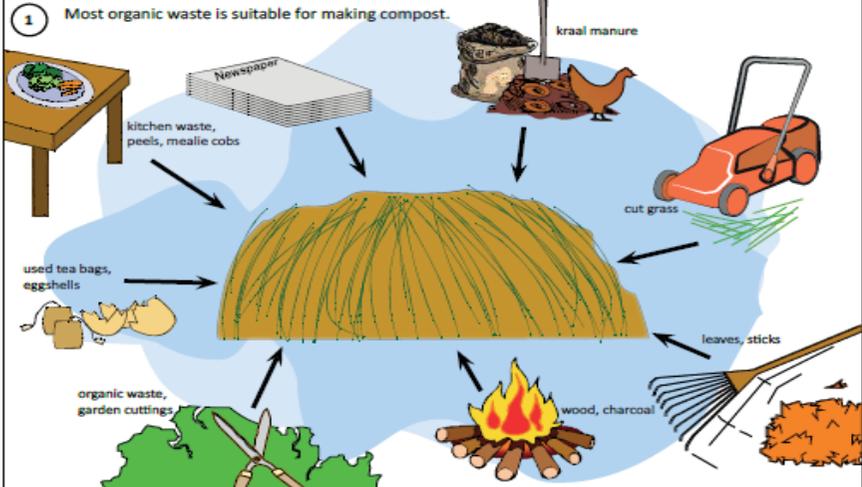
Nematode
- 11 Remove all the weeds. Weeds compete with the crops for nutrients, water and light.
- 12 Spray with organic remedies once pests are noticed. Use crop rotation, but avoid tomatoes. Burn diseased plants.
- 13 Harvest: Pick big leaves weekly.

Appendix D: Compost Nature's Fertilizer

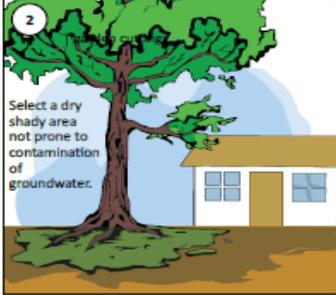
COMPOST NATURE'S FERTILIZER



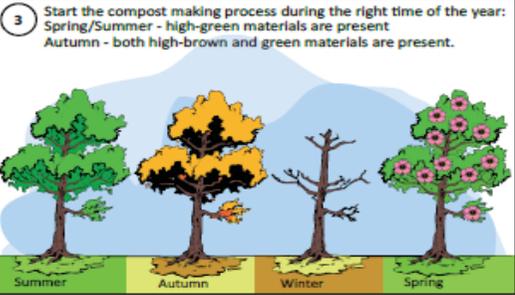
1 Most organic waste is suitable for making compost.



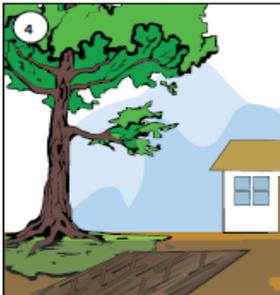
2 Select a dry shady area not prone to contamination of groundwater.



3 Start the compost making process during the right time of the year:
Spring/Summer - high-green materials are present
Autumn - both high-brown and green materials are present.



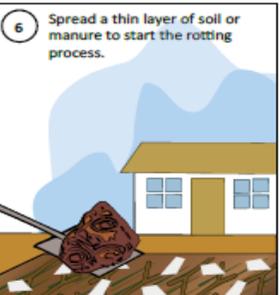
4 Use rough sticks or mealie cobs for the bottom layer. This will allow air into the compost heap.



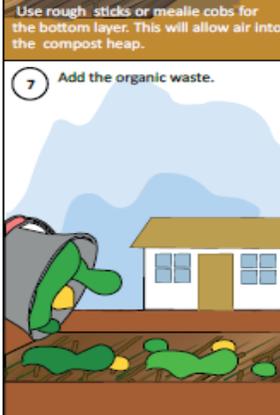
5 Add a layer of newspaper. Water well, but do not soak.



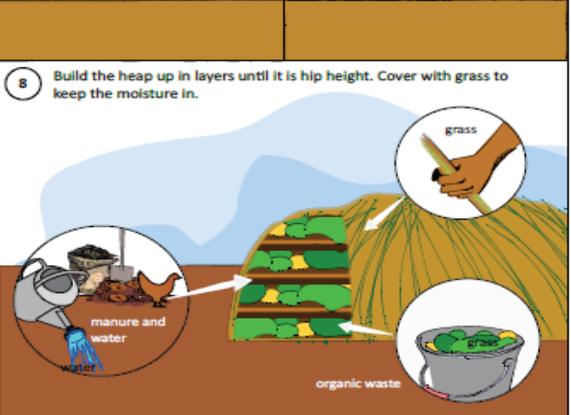
6 Spread a thin layer of soil or manure to start the rotting process.



7 Add the organic waste.



8 Build the heap up in layers until it is hip height. Cover with grass to keep the moisture in.



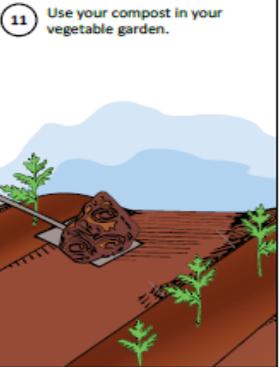
9 Turn the heap over after 6 weeks to let air in. Water again, but do not soak.



10 Your compost should be ready after 3 months.



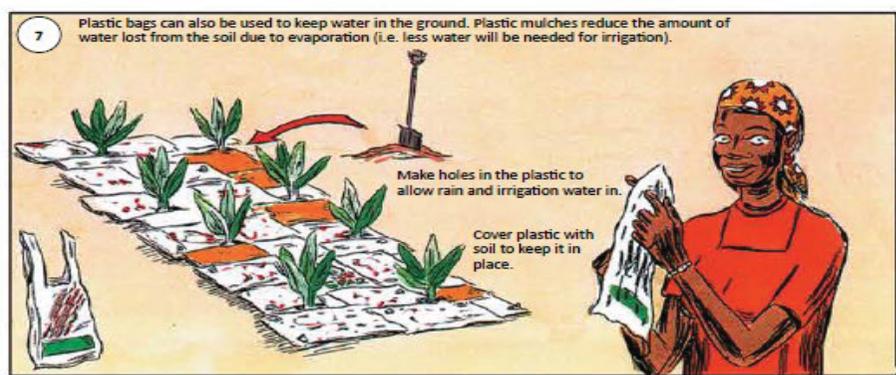
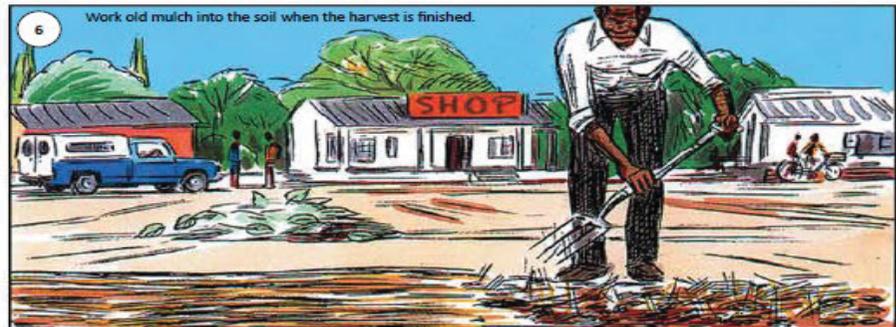
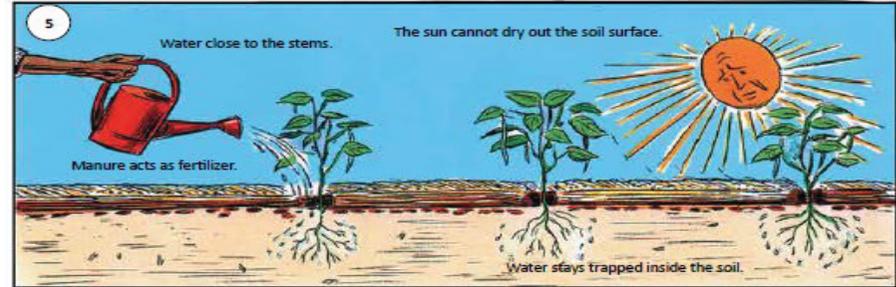
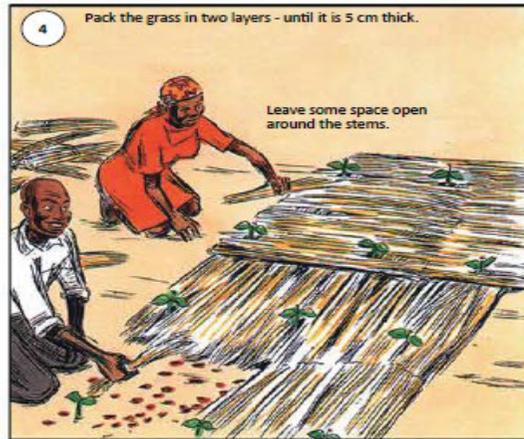
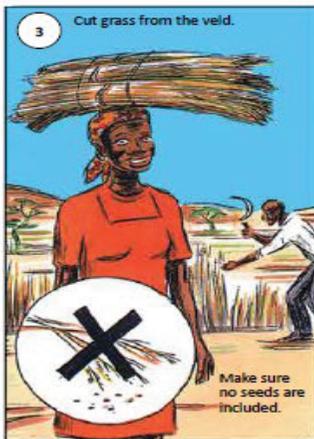
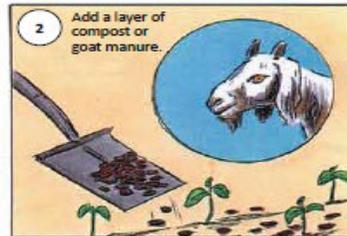
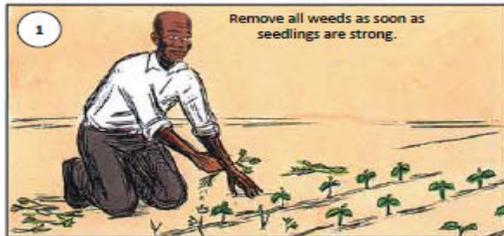
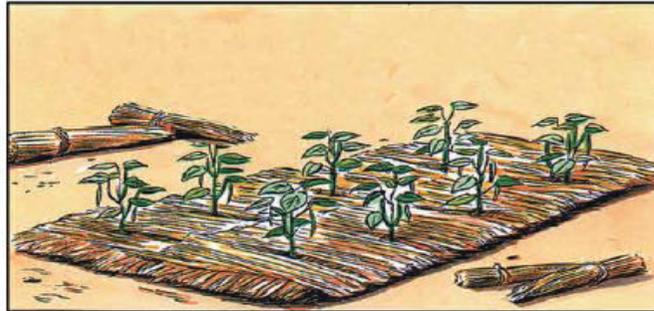
11 Use your compost in your vegetable garden.



Appendix E: Mulch a blanket on the soil

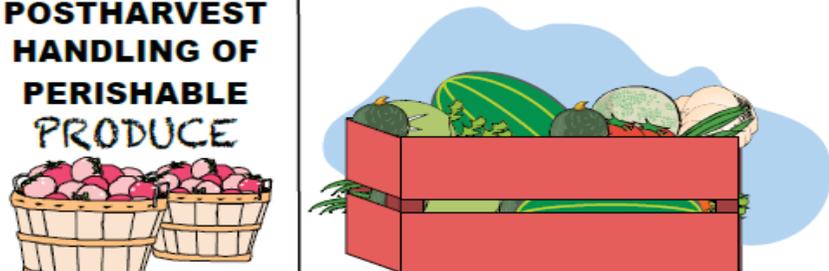
MULCH

A BLANKET ON THE SOIL



Appendix F: Postharvest Handling of Perishable Produce

POSTHARVEST HANDLING OF PERISHABLE PRODUCE



1 Harvest carefully, avoid injuring the produce.

2 In-field handling: Because of the perishable nature of vegetables, they should be transported as soon as possible from the field to the working area/shade/packing house to minimise injury.

3 Sort produce to give assurance of quality produce. Avoid cracked, insect damaged or rotten produce.

4 Clean or wash produce with clean, running water.

5 Grade produce according to size/colour/marketable/non-marketable.

6 Produce can either be transported to a market or stored in a well-ventilated cool area and in strong, packing material, suitable for stacking.

In general, proper storage facilities should include temperature control, humidity control, air circulation and maintenance of space between containers for adequate ventilation. Avoid incompatible product mixes.

7

8 A storage facility can also be constructed from simple materials, such as burlap and bamboo.