VEGETABLE PRODUCTION FOR SMALLHOLDER FARMERS

A guide for Conventional Vegetable Farming

IN OPEN FIELD

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This guide is not a substitute for technical assistance. Farmers are encouraged to always contact extension officers/ technical advisors for any technical aspect as they produce their vegetables.

In addition, this guide does not guarantee good yields. Farmers are encouraged to follow recommended good farming practices all the time.

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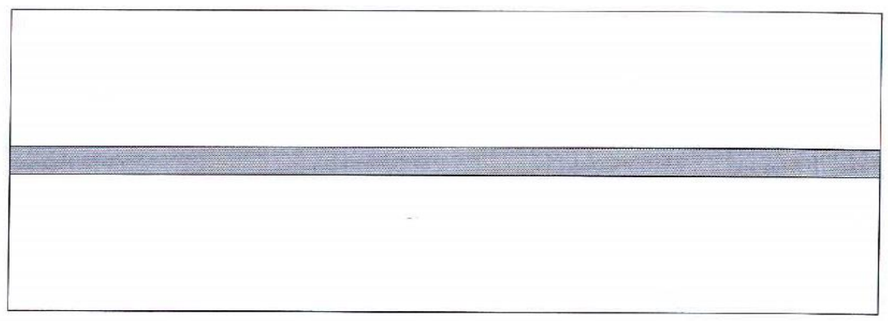
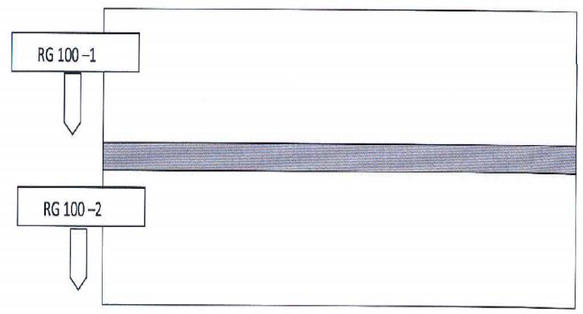
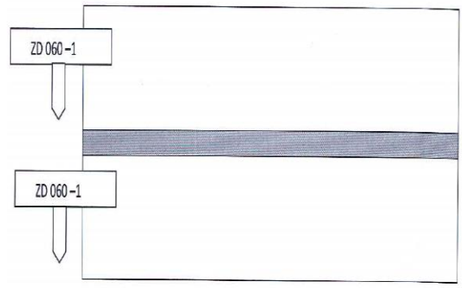
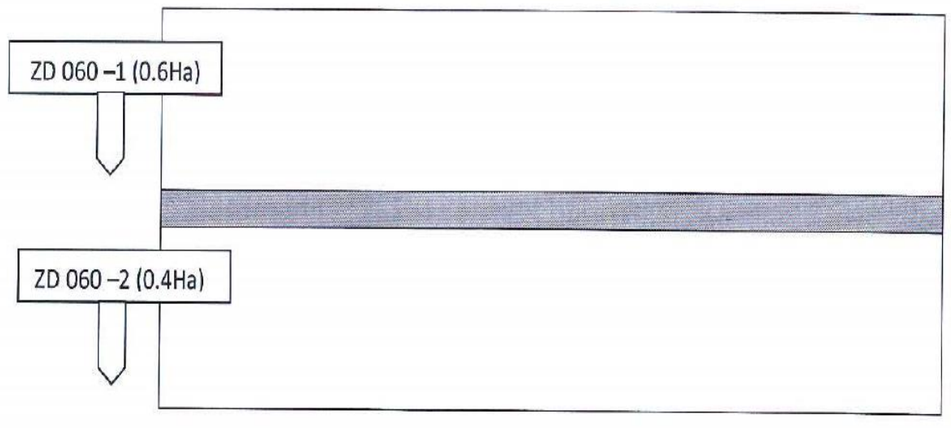


2 NAME YOUR FIELDS USING YOUR FARMER CODE OR INITIALS AND FIRST TWO DIGITS OF YOUR ID NUMBER

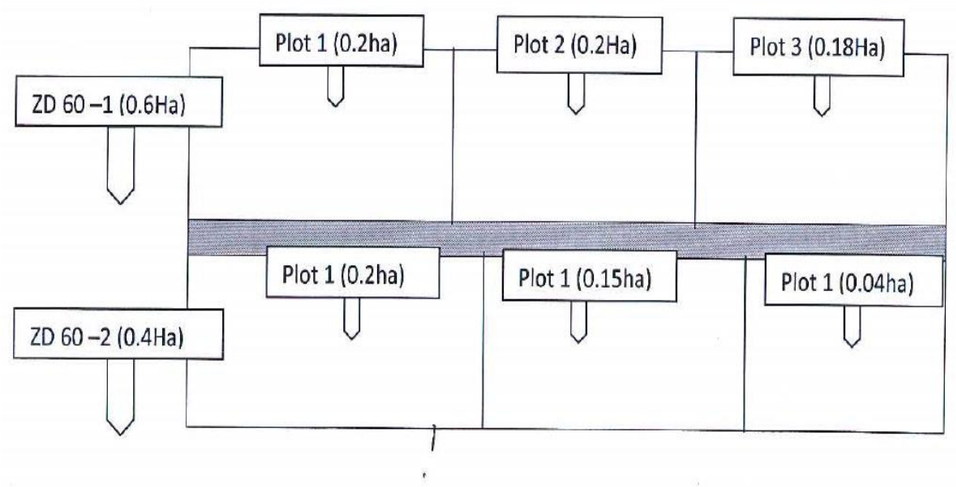




3 MEASURE YOUR FIELDS AND WRITE AREA ON FIELD LABELS



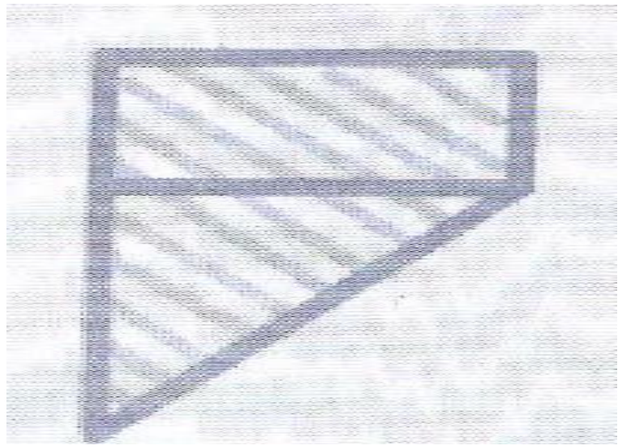
4 IF FIELD IS DIVIDED INTO PLOTS, LABEL PLOTS AND MEASURE THEIR SIZES



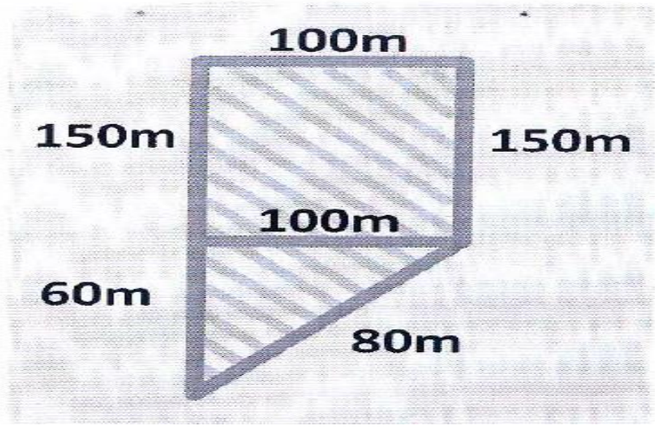
Source: Discussions by technical advisors

GUIDE FOR MEASURING FIELDS

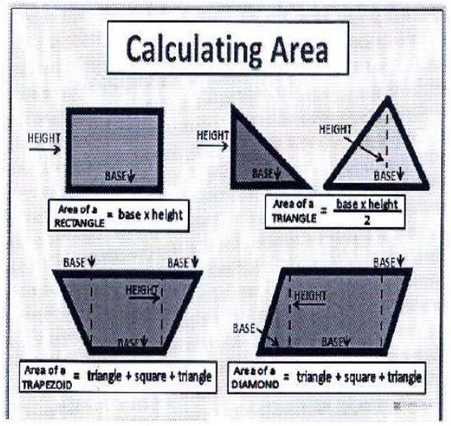
1 DIVIDE YOUR FIELD INTO RECTANGLES AND TRIANGLES



2 MEASURE THE PERIMETER OF EACH SHAPE IN METERS



3 CALCULATE THE AREA OF EACH SHAPE

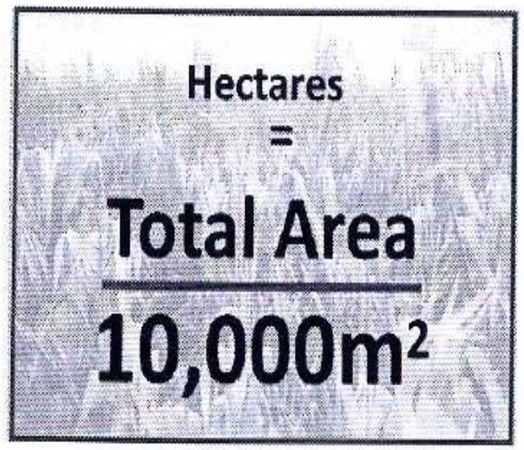


Area of RECTANGLE = 150m x 100m = 15,000m^2

Area of TRIANGLE = (100m x 60m) / 2 = 3,000m^2

TOTAL Area = 15,000m^2 + 3,000m^2 = 18,000m^2

4 CONVERT THE TOTAL AREA INTO HECTARES



Hectares = 18,000m^2 / 10,000m^2 = 1.8 hectares

Source: TechnoServe's Farming as a business curriculum

GUIDE FOR COLLECTING A SOIL SAMPLE

IMPORTANTANCE OF SOIL TESTING

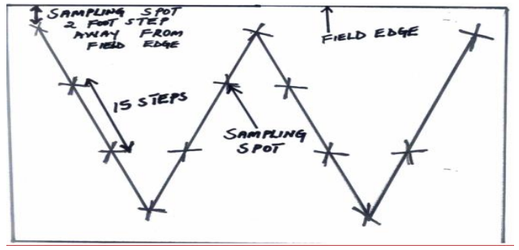
- Helps farmer to meet fertilizer requirement of the crop
- Informs farmer if liming is necessary
- It informs farmer on how much fertilizer has been removed by crops and how much needs to be added back to the soil

Sample your soil every year

SAMPLING MATERIALS

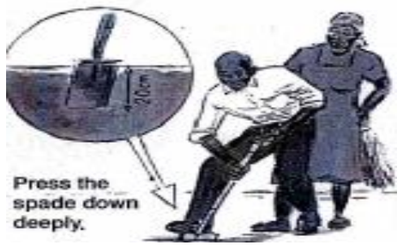
1. Plastic bucket
2. Trowel
3. Sampling bag
4. Hoe / spade
5. Pegs
6. Stick

1 DIVIDE YOUR FIELD WITH A W SIGN AND PUT PEGS IN SAMPLE AREAS



2 CLEAN SAMPLING SPOT TO REMOVE GRASSES AND STONES

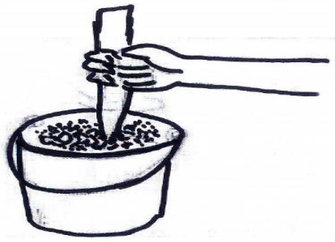
3 INSERT SPADE INTO THE SOIL IN PEGGED AREAS TO COLLECT SOIL SAMPLE



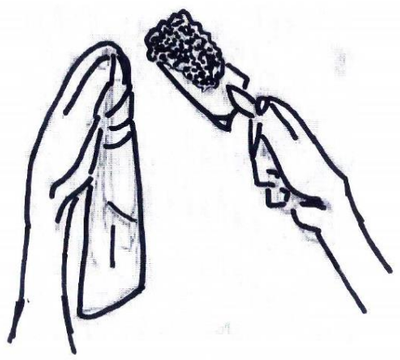
4 REMOVE SPADE WITH SAMPLE FROM THE SOIL AND TAKE A HAND TROWEL FULL OF SAMPLE

5 ADD ALL SOIL SAMPLES TOGETHER IN A BUCKET

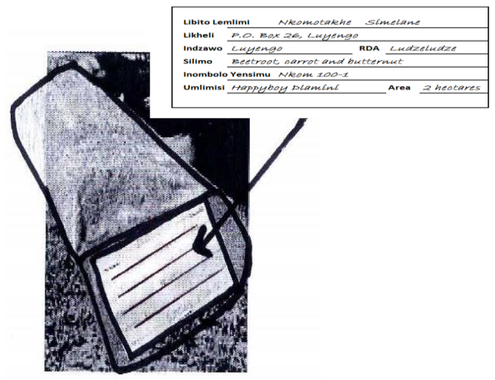
6 MIX SOIL SAMPLES THOROUGHLY



7 SCOOP 2 TROWELS FULL OF SAMPLE AND PUT IT INTO PLASTIC BAG



8 SEAL PLASTIC BAG AND LABEL IT



9 TAKE YOUR SAMPLE TO THE NEAREST RDA OR MALKERNS RESEARCH OR ANY SOIL TESTING FACILITY

- Soil samples should preferably be sent as a group by farmers from the same area

1 SPEAK TO EXTENSION OFFICERS IN RDA OR MALKERNS RESEARCH AND LEAVE YOUR SOIL SAMPLE

- Wait for a maximum of 2 weeks for your results to be released

1 READ RESULTS ONCE YOU RECEIVE THEM AND CONTACT EXTENSION OFFICER FOR INTERPRETATION

OTHER IMPORTANT CONSIDERARTIONS

- Avoid sampling soil from spots that have animal manure
- Plots that have accumulations of washed soils should be sampled separately from other homogenous soils – they should be separated into plots
- If soil has already been ploughed, soil should be collected from the top
- Farmer can use any other tool if there is no trowel as long as it is not rusting

Source: Malkerns Research Station, Discussions by Technical advisors

GUIDE FOR APPLYING LIME

IMPORTANCE OF LIMING

- Corrects soil pH
- Increases amount of nutrients that a plant can absorb from the soil

WHEN SHOULD LIME BE APPLIED

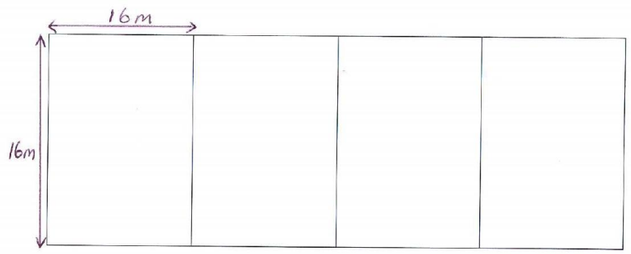
- Test your soil first
- Use soil test results to know the quantity of lime that has to be applied

IMPORTANT CONSIDERATIONS

- Liming can be done on the same day when planting has to take place. There is no waiting period, except when planting root vegetables
- Lime should not be applied on planting lines only, it should be spread on the entire plot or field
- Root vegetables should not be planted immediately after liming, they should follow another crop
- Use soft lime so that it can react very fast
- Animal manure is also useful in correcting soil pH, however, chicken manure should not be used at all

1 PLOUGH YOUR FIELD TO A DEPTH OF 30 cm

2 DIVIDE FIELD INTO SQUARES THAT CAN FIT A 50 KG BAG OF LIME (see appendix 2 for more information on quantities)

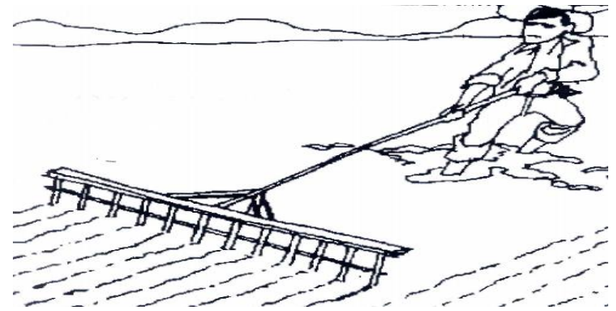


3 PLACE A 50 KG BAG OF LIME ON EACH SQUARE

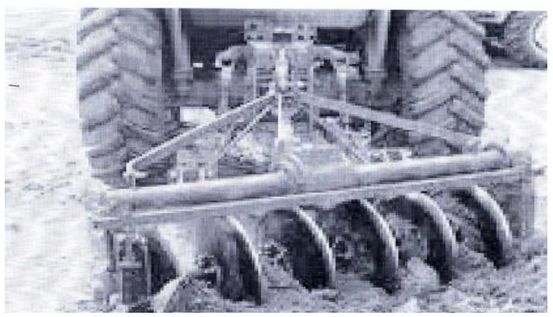
4 USE HAND TO SPREAD LIME ON SQUARE BOUNDARIES THEN BROADCAST IT IN SQUARE IN ZIG ZAGS

- A LIME SPREADER CAN ALSO BE USED IF IT IS AVAILABLE

5 USE RAKE TO SPEAD LIME EVENLY IN THE WHOLE FIELD



6 HARROW WITH DISC TO MIX WITH THE SOIL



Source: Malkerns Research Station, Discussions by Technical advisors

TYPES OF DISEASES

	Type of disorder	Description	Examples
1	Pathogenic disorders	These are diseases caused by harmful living organisms which invade plants and live on or in them to survive and reproduce. These organisms include bacteria, fungi, viruses and nematodes. Bacteria and fungi are very small organisms which cannot make their own food. Fungi and bacteria obtain their food by penetrating plant tissues and in the process injure plant tissues, thus producing disease symptoms. Nematodes are very small worms which live in the soil and attack nearby plant roots. If they enter to feed and multiply on roots they cause them to stunt and distort. Viruses are transmitted by sucking insects which feed on diseased plants and then carry the virus on their mouth parts to healthy plants. Common virus carriers are thrips, aphids and leafhoppers. Some viruses are transmitted through seed.	The following are examples of pathogenic disorders: • Early blight • Bacterial Leaf spots • Downey mildew • Powdery mildew • Bacterial wilt
2	Non pathogenic disorders	These are diseases which are caused by adverse growing conditions such as poor soil types, adverse weather conditions and fertilizer element deficiencies or mineral toxicity. For example, too much nitrogen, phosphorus and potassium can damage a range of crops by burning plant leaves or sometimes by inducing deficiency of other plant nutrients	The following are examples of non pathogenic disorders: • Fruit cracking • Blossom end rot • Sunscalds • Cat face

COMMON PESTS

	Name of pest	Description of damage caused	Picture of pest
1	Red spider mite	Red spider mites cause damage by sucking plant juices from leaves. At first, the damage shows up as light dots on the leaves; sometimes the leaves take on a bronze colour. As feeding continues, the leaves turn yellowish or reddish and drop off. Often, large amounts of webbing cover leaves, branches, and fruit. Damage is usually worse when there is water stress. Loss of leaves can have a significant impact on yield and may lead to sun-burning.	 
2	American Bollworm	Feeds on pods, stems and fruits of a wide range of vegetables and characteristically on green tomatoes causing rotting	
3	Aphids	Large populations of aphids can turn leaves yellow and stunt shoots; aphids can also produce large quantities of a sticky substance known as honeydew, which often turns black with the growth of a sooty mould fungus. Some aphid species inject a toxin into plants, which causes leaves to curl and further distorts growth. A few species cause gall formations. Aphids may transmit viruses from plant to plant on certain vegetables.	
4	Thrips	Thrips feeding on plants can damage fruit, leaves, and shoots and very noticeably affect plants' general appearance. Thrips can stunt plant growth and cause damaged leaves to become papery and distorted, develop tiny pale spots, and drop prematurely. On some plants thrips can cause severe stunting.	
5	Corn borer	Larvae feed on leaves of plants and bores into tomato and pepper fruit and feed or bore into bean pods.	
6	White fly	Attack a wide range of vegetables causing them to dehydrate. White flies transmit viruses that cause yellow leaves and stunted growth. They live in groups under the leaves of plants	
7	Cutworm	Cutworm cut off young plants at the soil surface.	

COMMON PESTS

	Name of pest	Description of damage caused	Picture of pest
8	Leaf miner	Leaf miners puncture small holes on leaves to feed on plant juices. These punctures eventually turn white. The most obvious evidence of leaf miners is the twisting trails the larvae leave as they feed beneath the leaf surface. The mine becomes longer and wider as the larva grows. Unusually heavy damage can slow plant growth and may cause infested leaves to drop.	 
9	Nematodes	Nematodes cause swellings on the roots of affected plants. The nematodes feed and develop within the swellings. The formation of these swelling damages the water and nutrient uptake abilities of the roots.	
10	Millipede	Millipedes eat roots, growing points and stems	
11	Tuber Moth	The young caterpillars quickly eat into the leaves and feed between the upper and lower surfaces, leaving transparent patches. From the leaves, they may work down the leaf stalks into the stems, causing wilting and killing parts of the plant. The caterpillars usually start attacking tubers causing holes in them.	 
12	Fruit Fly	Fruit flies cause direct damage by piercing fruit skin to lay eggs. The eggs hatch into larvae which feed on the fruit leading to fruit deformation. They provide entry for pathogens which increase fruit decay, making fruits unsuitable for human consumption	 
13	Army worm	Larvae eat large irregular holes or transparent patches in foliage. They also burrow into the crown or center of the head on lettuce, or on the buds of cole crops.	
14	Diamond back moth	Larvae eat many small holes on underside of leaves.	 

CULTURAL PRACTICES FOR SLOWING THE SPREAD OF PEST AND DISEASES

	Cultural practices	Description of cultural practice
1	**Soil tillage**	Tillage should be done early enough before planting to allow decomposition of raw organic matter such as manure or green plant material. This usually requires 6 weeks under warm temperatures and longer at low temperatures. Organic material that has not decomposed can be a source of diseases
2	**Crop rotation**	Crop rotation will help prevent the build up of disease causing organisms in vegetables. Rotate to crops that do not host disease. This is important in starving the pathogen and depleting its resting stages. As several vegetables of the same family are affected by the same diseases, it is not a good practice to grow vegetables of the same family in rotation. Avoid planting the same crop species or closely related species in the same place more than once every 3 years. Do not plant the same vegetable more than once in a year on the same piece of land
3	**Sanitation**	Many disease causing organisms survive in old plant remains in the field. Removal or ploughing down of crop remains discourages pathogens from growing and diseases from spreading. Tools should be disinfected before being used again so that they can be freed of pathogens Keep field edges clean from weeds and old crops
4	**Weeding**	Timely weed plots to prevent pathogens from hiding on weeds
5	**Seed treatment**	Some disease causing organisms are carried on the surface of seed/ seedlings and can be controlled by a single fungicide treatment before planting.
6	**Use disease free seeds/ seedlings**	Avoid buying seeds/ seedlings which are infected by diseases or disease causing pathogens. This can be done by buying certified disease free seed.
7	**Planting dates**	Plant vegetables at their recommended planting times. Some vegetables can be affected by certain diseases if planted at the wrong time
8	**Staking or trellising**	Trellising prevents soil contact with the foliage and fruit. Air circulation is better when the plants are trellised thus promoting better drying of foliage and reducing diseases. Pesticides can be effectively applied on trellised plants
9	**Irrigation**	Irrigation can influence the development and severity of most foliage diseases. Wet foliage is favourable for the development of most diseases. To reduce infection, use surface irrigation, if overhead irrigation is used, then it should be done in the late morning and mid afternoon to allow foliage to dry before evening. Uniform soil moisture should be maintained. Excessive soil moisture should be avoided as it can result in increased root and stem rot diseases. It is best to work in the field when foliage is dry to reduce the spread of diseases
10	**Use of resistant varieties**	Many vegetable varieties are resistant to specific plant diseases. Use them whenever possible. Grow resistant varieties in areas which are affected by specific diseases e.g. growing varieties which are resistant to fusarium wilt in soils which have a history of being infested by disease
11	**Proper plant spacing**	It is important to plant at the recommended spacing. Wet conditions occur if plants are crowded and unable to dry quickly. Many disease causing organisms require moisture to infect plants. Pesticides will not be able to penetrate through dense foliage.
12	**Avoid using tobacco/ avoid smoking**	Avoid using tobacco or smoking while working in tobacco mosaic susceptible crops, such as tomato and pepper. Tobacco mosaic virus is carried in tobacco products and is easily transmitted to susceptible vegetables on workers' hands. Workers should wash their hands thoroughly in soap and water after handling tobacco and before they work with tobacco mosaic susceptible plants

13	**Control weed host plants**	Controlling or cleaning weed host plants helps prevent the spread of diseases.

AVOID PLANTING CROPS FROM THE SAME GROUP IN THE SAME PIECE OF LAND MORE THAN ONCE IN THE SAME YEAR

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
• Cantaloupe • Cucumbers • Melons • Pumpkin • Butternut • Baby marrows • Baby gem • Patty pans	• Brussels sprouts (Baby cabbage) • Cabbages • Cauliflower • Broccoli • Lettuce • Mustard • Radish • Swiss chard • Spinach • Turnip	• Eggplant • Potatoes • Okra • Pepper • Tomatoes • Chillies • Groundnuts • Tobacco	• Beetroot • Carrot • Garlic • Onions • Shallot • Sweet potatoes	• Sweet corn • Baby corn	• Green Beans • Sugar beans • Cowpeas • Peas

GUIDE FOR GROWING GREEN PEPPER

VARIETIES

- **Common varieties are: Capistrium, capistriano, capricon and revelation**
- **Only select varieties that are demanded by the intended market**

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

- **Highveld – August to February**
- **Middleveld – August to February**
- **Lowveld – March to July**
- **Lubombo – March to July**

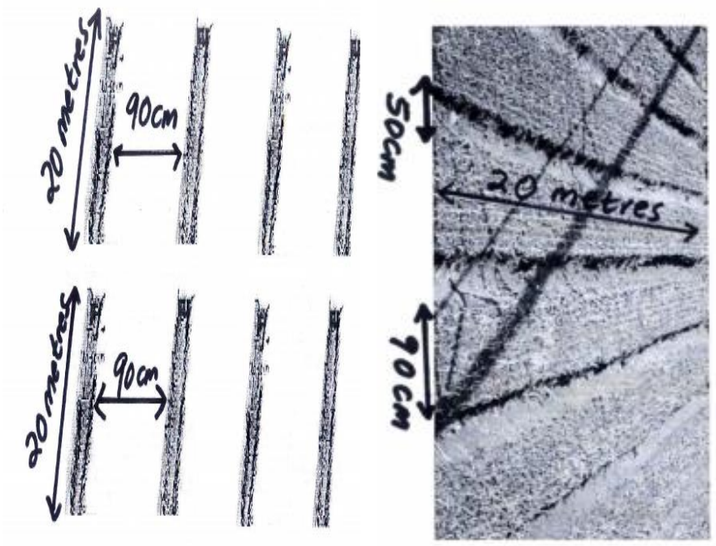
This is a warm season crop.
(See appendix 1 for more information on planting calendar)

1 PLOUGH YOUR LAND

- Land preparation will depend on availability of machinery and contract requirements
- Use disc plough to plough deeply
- Harrow to prepare a fine seedbed

2 OPEN PLANTING LINES

- Prepare 20 m long planting lines or beds
- Spacing between lines: 90 cm
- Spacing between holes should be 50 cm



3 APPLY BASAL FERTILIZER

- Always test your soil to know how much fertilizer to apply
- Fertilizer should be applied before planting
- Mix fertilizer with the soil before planting
- Apply fertilizer per planting station
- Do not mix basal fertilizer with urea or LAN

4 PLANT

- Fumigate soil to kill nematodes
- Wet the soil the day before planting
- Spray with Decis Forte a week or a day before planting to control cutworm
- Plant using a spacing between plants of 45 cm
- Use rope to mark lengths of 45 cm

5 IRRIGATE YOUR CROP

- Farmer is encouraged to use surface irrigation for irrigating green pepper
- If irrigating with sprinklers, from flowering onwards they should not be used to avoid flower drop and fungal diseases
- As the frequency of irrigation depends on soil type, farmer is encouraged to know his soil
  - Irrigate more frequently the first week after planting
  - Irrigate more frequently from week 2 until establishment
  - Irrigate more frequently from flowering onwards
  - Don't wait for soil to be dry before irrigating, keep it moist at all times
- Depending on availability of money, farmer can use a tensiometer to measure moisture content

6 APPLY TOP DRESSING FERTILIZER

- Always follow recommendations of a soil test
- Irrigate first before applying fertilizer so that it can dissolve
- Apply fertilizer as a band making sure it does not touch plant
- First application should be at 5 weeks after transplanting. Second application should be after harvesting of second fruits
- Fertilizer should be applied per planting station 5 cm away from the plant / stalk

7 WEEED YOUR PLOT

- Control weeds before crop is planted
- If using chemicals, apply pre-emergence herbicide 3 weeks before planting. Always use approved chemicals. Always consult with technical advisor before using herbicides
- Irrigate first before using herbicide
- If using hand, weed regularly using a hoe to have a weed free plot
- Do not weed deeply to avoid damaging roots
- If implements are available weed mechanically without causing injury to plants

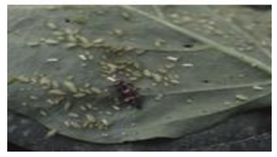
9 HARVEST

- Harvest firm fruits that have reached full size and are fully green
- Harvest twice a week to achieve maximum yields
- Harvest fruits directly into a crate and don't throw them
- Stalk should be cut closer to the fruit
- Store harvested produce in a cool place or under shade

8 CONTROL PESTS AND DISEASES

- Stick to a spray program to prevent the occurrence of fungal diseases
- Scout to identify pests
- Contact an extension officer who will assist you with a spray programme
- When harvesting period is near, use chemicals that have a short withdrawal period
- See next page for more details on control of pests and diseases

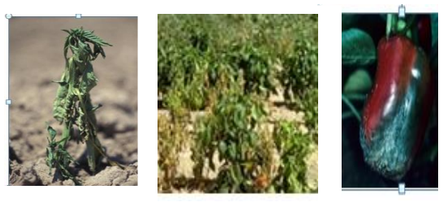
GUIDE FOR PEST CONTROL IN GREEN PEPPER

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Red spider mite	Feeds on underside of leaves causing a yellow or bronze colour. Leaves affected by mites curl downwards		- Avoid ploughing 2 different fields with the same implements - Avoid moving from infested to none infested fields - Plough down and incorporate all crops after harvest - Keep field edges clean - Uproot infested plants and throw them away Spray with agromectin or profenophos	Agromectin – 15ml Profenofos – 100 ml	Agromectin – 3 days Profenofos – 4 days
2	American Bollworm	Feeds on fruit		Spray with Decis Forte or Cypermethrin Remove infected plants	Decis Forte – 5ml Cypermethrin – 5ml	Decis Forte – 3 days Cypermethrin – 2 days
3	Aphids	Sucks plant nutrients resulting in stunted plants. Leaves may also become yellow and deformed. Aphids transmit plant viruses		Spray with Malasol or Acephate or aphicide Remove all crop remains as soon as possible after harvesting. Remove weeds surrounding field	Malasol –35 ml Acephate – 20g Aphicide	Malasol – 1 day Acephate – 3 days Aphicide
4	Thrips	Insects feed on plant juices from smaller plants and flowers. Leaves affected by thrips curl upwards developing a boat-shaped appearance. Damaged fruit is distorted		Spray with Decis Forte or Malasol or cypermethrin Remove all crop remains as soon as possible after harvesting. Use resistant seed varieties	Decis forte – 5 ml Cypermethrin – 5 ml Malasol – 35 ml	Decis forte – 2 days Cypermethrin – 2 days Malasol – 1 day
5	Corn borer	Larvae bore into and feed on fruit causing decay. Damaged small fruits fall from plant		Spray with Decis Forte or Cypermethrin Avoid planting pepper closer to maize. Destroy all green pepper residues after completion of harvesting Removed weeds around field edges	Decis Forte – 5 ml Cypermethrin – 5 ml	Decis Forte – 3 Cypermethrin – 2 days
6	White fly	Feeds on plant nutrients and transmits plant viruses		Spray with malasol or hamba fruit fly	Malasol – 35 ml Hamba Fruit Fly	Malasol – 1 day Hamba Fruit Fly

Always seek assistance from technical advisor on recommended pesticides. As pesticide trade names change from time to time, consult with technical advisor or input supplier on trade names performing similar functions to recommended pesticides. All pesticides should be mixed with a sticker so that they stick on plants – this should apply to all vegetables. An example of sticker which farmers can use is NUFILM. Farmers should consult

GUIDE FOR CALIBRATING A KNAPSACK SPRAYER

GUIDE FOR DISEASE CONTROL IN GREEN PEPPER

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Bacterial spot	Small water-soaked spots appear on leaves starting from the underside. As spots grow larger, they become purplish- grey with a black centre. Affected leaves turn yellow and fall. Affected fruits have spots which look like blisters		Rotate for 2 years from tomato. Use resistant varieties and buy disease free seedlings Rotate crops Plant away from tomatoes Spray with Bravo or Copper oxychloride or Ridomil	Bravo – 20 ml Copper oxychloride – 100 g Ridomil – 50 g	Bravo – 3 days Copper oxychloride – 3 days Ridomil – 7 days
2	Phytophtora blight	Affects all parts of plants. It causes black lesions on stems, wilting of plant, circular brown lesions, leaves and dark lesions on fruits and root rot.		Do not plant on poorly drained soils. Rotate away from potatoes, eggplant and tomato for three years As a preventative measure spray with a mixture of Copper Oxychloride and Dithane every 14 days until flowering When disease has occurred – spray with bravo or ridomil	Copper Oxycloride - 100g Dithane – 40g Bravo – 20 ml Ridomil - 50g	Copper Oxycloride - 3 days Dithane – 7 days Bravo – 3 days Ridomil - 7 days
3	Powdery mildew	Affected plants have whitish spots on lower leaves, yellow discolorations appear on upper leaves causing leaves to fall from plant		Spray a mixture of copper oxychloride and dithane every 14 days until flowering When disease has occurred – spray with bravo or ridomil	Copper oxychloride – 100 g Dithane – 40g Bravo – 20 ml Ridomil - 50 g	Copper oxychloride – 3 days Dithane – x days Bravo – 3 days Ridomil - 7 days
4	Damping off	Smaller seedlings suddenly collapse or become stunted		Nursery beds should be on well drained soils and well ventilated to prevent high humidity Dip seedlings by their roots in ridomil for five minutes before transplanting	Ridomil - 50 g	Ridomil - 7 days
5	Bacterial wilt	Leaves wilt followed by entire wilting of the plant with slight or no yellowing of the leaves It is promoted by high rainfall coupled with warm weather		Rotate to none related crops Uproot infected plants and destroy them		

GREEN PEPPER SPRAY PROGRAM

Time of application	Name of pesticide	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting	Purpose of pesticide
AT PLANTING	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days); cypermethrin (2 days)	To control cutworm
	Nematicide	Nematicide / Curaterr	Nematicide / Curaterr	To control nematodes
WEEK 2	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control cutworm and aphids
WEEK 4	Bravo or Ridomil	Ridomil (40g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of aphids and red spider mites
WEEK 6	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control cutworm and aphids
WEEK 8	Bravo or Ridomil	Ridomil 100g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of aphids
WEEK 10	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control red spider mites
WEEK 12	Bravo or Ridomil	Bravo (20ml)	Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2days) / cypermethrin (2 days)	For control of American bollworms
WEEK 14	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control American bollworms
WEEK 16	Bravo	Bravo (20ml)	Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of American bollworms

From week 18, Spray with bravo and decis in 2 week intervals. Alternate with copper oxychloride and malasol				

PHYSIOLOGICAL DISORDERS IN GREEN PEPPER

	Name of physiological disorder	**What are the symptoms of physiological disorder**	**Picture of physiological disorder**	**How can it be avoided or corrected**
1	Blossom end rot	It is a dark spot/ rot on the blossom end of the fruit. This disorder is associated with calcium deficiency		Make sure that green peppers are not water stressed, irrigate them well. Apply the right amount of fertilizer based on soil test results for green pepper. Ensure that you plant at correct soil pH Spray with a calcium solution if fruits show symptoms of blossom end rot Remove fruits with blossom end rot from plant.
2	Fruit cracks	Very fine superficial cracks on the surface of the pepper fruit which gives a rough texture to the fruit. The development of these cracks are associated with sudden changes in the growth rate of the individual fruit		Irrigate uniformly throughout the crop's growing season
3	Sunscald	Occurs when fruit is not adequately shaded by leaf cover. Large section of the exposed fruit can develop grey or brown paper-thin areas. These areas render the fruit unsellable		Avoid unnecessary damage to the plants canopy during harvesting that would result in exposing the developing fruit to sunlight.
4	Poor colour development	Occurs when peppers do not receive sufficient light into the canopy.		At maturity do not allow peppers to develop to colours beyond their green without picking them

GUIDE FOR GROWING TOMATOES

1

VARIETIES

- **Only select varieties that are demanded by the intended market**
- **Common fresh market varieties are: star 9003, Star 9009, star 9008, Disco and HTX**

2

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

- **Highveld – August to February**
- **Middleveld – August to February**
- **Lowveld – March to July**
- **Lubombo – March to July**

(see appendix 1 for more information on planting calendar)

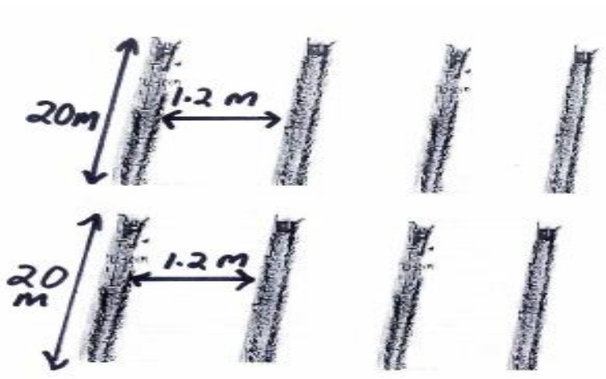
3

PLOUGH YOUR LAND

- Use disc plough to plough deeply
- Harrow to prepare a fine seedbed

OPEN PLANTING LINES

- Prepare 20 m long planting lines or beds
- Spacing between lines: 90cm to 1.2 meters



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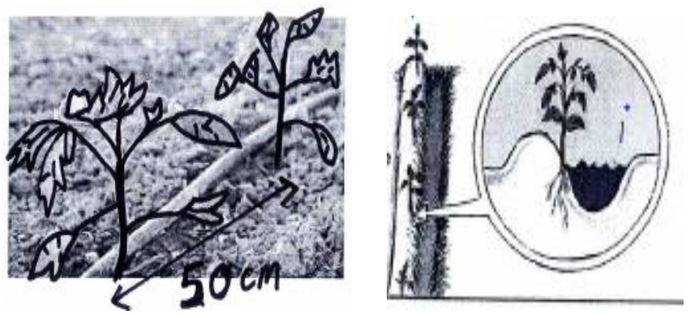
APPLY BASAL FERTILIZER

- Always test your soil to know how much fertilizer to apply
- Fertilizer should be applied before planting
- Mix fertilizer with the soil before planting
- Apply fertilizer per planting station
- Do not mix basal fertilizer with urea or LAN

PLANT

- Do not delay transplanting
- Wet seedlings with chemical a night before transplanting to control bacterial wilt
- Number of plants should be 16 800 per hectare
- Wet the soil before planting
- Spray to control cutworm



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IRRIGATE YOUR CROP

- Use surface irrigation, if using overhead it should not be a sprinkler
- Sprinkler can only be used during early stages and stopped at the beginning of flowering
- As the frequency of irrigation depends on soil type, farmer is encouraged to know his soil
  - Irrigate more frequently during the first 2 weeks after planting
  - Irrigate regularly from week 3 until beginning of flowering
  - Irrigate more frequently from flowering
  - Do not wait for soil to be dry before irrigating, keep it moist

7

APPLY TOP DRESSING FERTILIZER

- Always follow recommendations of a soil test
- Apply recommended top dressing fertilizer at 5 weeks and at 8 weeks after transplanting
- Fertilizer should be applied per planting station 5 cm away from the plant / stalk
- Use foliar spray after 8 weeks

6

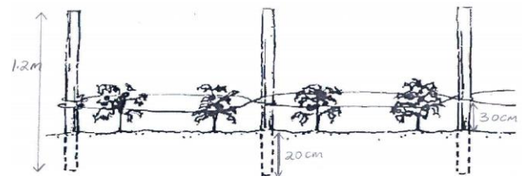
WEEED YOUR PLOT

- Herbicides are not recommended
- Avoid damaging plants during weeding
- Weed before applying any fertilizer
- If using hand, weed regularly using a hoe to have a weed free plot
- Do not weed deeply to avoid damaging roots
- If implements are available weed mechanically without causing injury to plants
- Keep stand free from weeds

8

STAKING AND TRELLISING

- Erect stakes as soon as you finish planting to minimise damage to roots. Height of stakes should be 1.2 meters and a diameter of 3cm or more
- Stakes should be spaced at 3m apart in between plants
- Drive stakes 20 cm into the ground
- Start trellising from 6 to 8 weeks putting first rope at 30cm above ground, second at 50cm, next rope at 70cm. If another rope is added it should be



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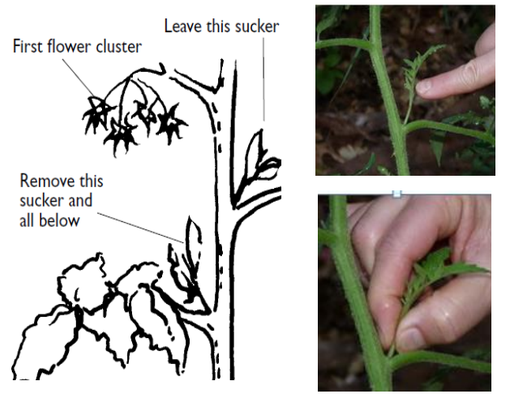
PRUNNING

- Start pruning at 7 weeks while plants are still soft
- Remove suckers below the first cluster of flowers



CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Develop a spraying programme with the advice of

HARVEST

- Follow specifications given by your market on the colour at which you should harvest

1

1

GUIDE FOR PEST CONTROL IN TOMATOES

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Cutworm	Feeds on young seedlings at ground level causing them to fall		Spray with Decis Forte or cypermethrin at planting Also spray when signs of cutworm are seen	Decis Forte – 5ml cypermethrin - 5ml	Decis Forte – 2 days cypermethrin – 2 days
2	Leaf miner	Eats through plant leaves leaving white trails. Leaves become weakened and heavy loss of leaves results in sunscald		Spray with Decis Forte or agromectin	Decis Forte – 5ml Agromectin – 12 ml	Decis Forte – 2 days Agromectin – 3 days
3	Aphids	They form a cluster on plant leaves sucking plant juices resulting in stunted and distorted growth. Aphids also spread diseases		Keep cultivated fields clean from weeds Spray with Profenofos or Decis forte or Malasol or aphicide	Profenofos – 100ml Malasol – 25 ml Decis – 5ml Aphicide	Profenofos – 4 days Malasol – 1 day Decis – 2 days Aphicide
4	Red spider mite	Feeds on underside of leaves causing pale spots on upper leaf surface. Leaves later turn yellow, become bronze and dry. Severe infestation is characterised by fine webbing		Spray with Profenofos or agromectin	Profenofos – 100ml agromectin – 15ml	Profenofos – 4 days agromectin – 3 days
5	American bollworm	Feeds on fruit		Destroy all remains of crop after harvest Spray with Decis Forte or cypermethrin as soon as flowering starts – repeat at 10 day intervals for best results	Decis – 5ml Cypermethrin – 5ml	Decis Forte – 2 days Cypermethrin – 2 days
6	Thrips	Suck plant juices from flowers and young fruits. Additional damage is the malformation of leaves and dropping of fruits		Spray with Profenofos in a weekly spray programme or malasol or decis forte	Profenofos – 100ml Malasol – 35 ml	Profenofos – 4 days Malasol – 1 day
7	Nematodes	Cause swellings on plants roots. Swellings interfere with the plants ability to take up nutrients. Affected plants are stunted		Practise crop rotation Use varieties that are resistant to nematodes Plough deeply Keep planted fields clean from weeds Always destroy infected plants and keep them away from field Apply nematicide / curatter as a row treatment at planting	Nematicide Curatter	Nematicide Curatter
8	White fly	Feed on plant juices leaving behind a sticky substance which becomes a host for sooty mould. The mould blocks sunlight from		Spray with Malasol / hamba fruit fly / grab	Malasol – 35 ml Hamba Fruit fly	Malasol – 1 day Hamba Fruit fly

GUIDE FOR DISEASE CONTROL IN TOMATOES

	Name of disease	What impact does it have on plants	Pictur	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Early blight	Circular brown spots appear on lower leaves and stems. Lower leaves turn yellow and fall. Brown spots also appear near stem of fruit. Severe infection cause all leaves to fall off exposing fruits to sunscald		Destroy all crop remains after harvest Fertilize and irrigate crop properly Alternate the following pesticides in a spray program: Bravo, Amistar, score and ridomil	Bravo – 20ml Amistar – 20ml Score – 15ml Ridomil – 50g	Bravo – 3 days Amistar – 7 days Score – 7 days Ridomil – 7 days
2	Leaf spot	Causes dark spots on leaves with tiny black spots on the centre		Spray with Bravo or Amistar or score	Bravo – 20ml Amistar – 20ml Score – 15ml	Bravo – 3 days Amistar – 7 days Score – 7 days
3	Bacterial wilt	Causes sudden wilting of plants without yellowing of leaves		Avoid planting in contaminated soils Choose resistant varieties Plant tomatoes in well drained soils Practice crop rotation Remove and destroy infected plants		
4	Bacterial spot	Causes small, dark greasy spots on leaves and stems of plants which eventually enlarge and dry to greyish brown. Raised spots appear on infected fruits. Infected young fruits fall off from the plant		Spray with Bravo or Amistar or score Practise crop rotation Remove all weeds from edges of field	Bravo – 20ml Amistar – 20ml Score – 15ml	Bravo – 3 days Amistar – 7 days Score – 7 days
5	Late Blight	Blue grey waters-soaked spots on leaves which turn brown. Irregular greasy spots on fruits and stem. Dark greasy spots appear on fruit and enlarge until the whole fruit is affected	 	Spray with ridomil or bravo Destroy all plants after harvest	Ridomil – 50g Bravo – 20ml	Ridomil – 7 days Bravo – 3 days
6	Fusarium wilt	Attacks mature plants at the green fruiting stage causing plants to turn brown and leaves on one part of plant turn yellow. Whole plant eventually wilts		Plant in soil that does not have a history of disease Plant in soil that does not have nematodes Use seedlings that are free from disease		
7	Powdery Mildew	Yellow spots form on upper leaf surface with a powdery covering on lower leaf surface. Severely affected leaves dry but do not drop from the plant.		Spray with amistar or copper oxychloride or dithane	Amistar – 20 ml Copper oxychloride – 100 g Dithane – 40g	Amistar – 3 days Copper oxychloride – 3 days Dithane – 7 days

TOMATO SPRAY PROGRAM

Time of application from transplanting	Name of pesticide	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting	Purpose of pesticide
AT PLANTING	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days); cypermethrin (2 days)	To control cutworm
	Nematicide	Nematicide / Curaterr	Nematicide / Curaterr	To control nematodes
WEEK 2	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control cutworm aphids
WEEK 3	Bravo or Ridomil	Ridomil (50g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of aphids and red spider mites
WEEK 4	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control red spider mites
WEEK 5	Bravo or Ridomil	Ridomil (50g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of aphids
WEEK 6	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control red spider mites
WEEK 7	Bravo or Ridomil	Ridomil (50g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of aphids
WEEK 8	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of bacterial spot
	Dithane M45	Dithane (40g)	Dithane (7 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control red spider mites
WEEK 9	Bravo or Ridomil	Ridomil (50g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of American bollworms
WEEK 11	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control American bollworms
WEEK 13	Bravo or Ridomil	Ridomil (50g) / Bravo (20ml)	Ridomil (7 days) / Bravo (3 days)	For control of early blight and late blight
	Decis Forte / cypermethrin	Decis Forte (5ml) / cypermethrin (5 ml)	Decis Forte (2 days) / cypermethrin (2 days)	For control of American bollworms
WEEK 15	Copper oxychloride	Copper oxychloride (100g)	Copper oxychloride (3 days)	For control of early blight and late blight
	Malasol	Malasol (35ml)	Malasol (1 day)	To control American bollworms

From week 17, Spray with bravo and decis in 2 week intervals. Alternate with copper oxychloride and malasol				

PHYSIOLOGICAL DISORDERS IN TOMATOES

	Name of physiological disorder	**What are the symptoms of physiological disorder**	**Picture of physiological disorder**	**How can it be avoided or corrected**
1	Blossom end rot	It is a dark spot/ rot that gradually widens and deepens. It develops on or near the blossom end of the fruit. Fruit with blossom end rot cannot be sold		Make sure that tomatoes are not water stressed, irrigate them well. Apply the right amount of fertilizer based on soil test results for tomato. Weed lightly and be sure not to damage roots of plants. Ensure that you plant at correct soil pH Spray with a calcium solution if plants show symptoms of blossom end rot Remove fruits with blossom end rot.
2	Fruit cracking	Cracks on fruits that occur mostly during rainy periods, or after a very long dry spell		Irrigate uniformly throughout the crop's growing season
3	Sunscald	Very dark green shoulders or bruises that appear when the fruit is still not mature. As the fruit develops, the shoulders then turn yellow and remain that way making the fruit bad for selling		During harvesting, avoid unnecessary damage to the plants canopy as it would result in exposure of the developing fruit to sunlight. Avoid excessive pruning of tomatoes.
4	Catface	Abnormal growth that occurs at the blossom end of the fruit often with rough ridges		Do not plant during cool season. Plant varieties which are suitable for season Avoid excessive pruning of tomatoes

GUIDE FOR GROWING POTATOES

VARIETIES

- **Grow varieties that are wanted by your market**
- **Common varieties are mondial, sifra and fiana**
- **BP1 is not suitable for chips but can be used for fresh consumption**

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

- **Highveld: July to February**
- **Wet Middleveld: June to February**
- **Dry Middleveld: July to February**
- **Lowveld: March to July**

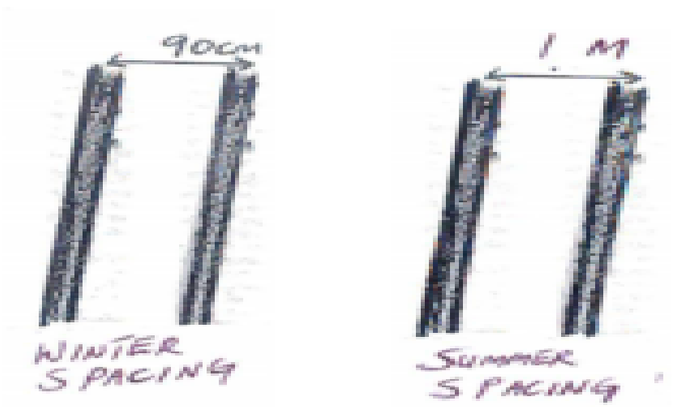
(See appendix 1 for more information on planting calendar)

1 PLOUGH YOUR LAND

- Plough with a disc plough to a depth of 25 cm
- If available apply manure and incorporate with a disc harrow
- If possible spray with a herbicide 6 weeks before planting

2 OPEN PLANTING LINES

- Prepare planting lines which are 90cm apart in winter and 1m apart in summer



3 APPLY BASAL FERTILIZER

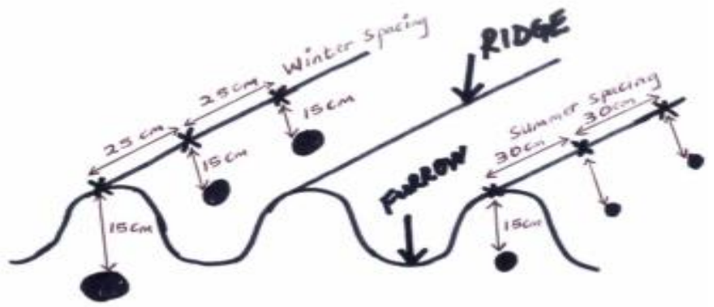
- Always test your soil to know how much fertilizer to apply
- Broadcast recommended amount of fertilizer at the bottom of furrow a week before planting or just before planting
- Cover fertilizer with soil to a depth of 2 to 3 cm

4 PREPARE SEEDS FOR PLANTING

- Do not buy sprouted seeds, they are not good for planting
- Use small to medium tubers for planting
- Do not use big tubers
- Use certified seeds and

5 PLANT

- Place seeds above fertilizer using a spacing between seeds of 25cm in winter and 30cm in summer
- Add 10 to 15 cm layer of soil on top of seeds



6 IRRIGATE YOUR CROP

- Do not use overhead irrigation once sprouts have started emerging
- Use surface irrigation after emergence e.g. furrow and drip
- As the frequency of irrigation depends on soil type, farmer is encouraged to know his soil
  - Irrigate regularly from planting to flowering
  - Irrigate more frequently from flowering to maturity
  - Do not wait for soil to be dry before irrigating, keep it moist
- Ensure that irrigation does not uncover seeds
- Cut off irrigation completely at maturity when leaves start drying

8 APPLY TOP DRESSING FERTILIZER

- Weed first before applying fertilizer
- Always follow recommendations of a soil test
- Broadcast recommended top dressing fertilizer evenly 5 cm away from plant stalk at 4 weeks after plants have emerged
- Do not exceed recommended quantities of fertilizer to avoid too much vegetative growth at the expense of tuber development

9 CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Develop a spraying programme with the advice of an extension officer
- Control pests and diseases by using recommended pesticides
- See next page for more details on pest and disease control

1 HARVEST

- To verify if potatoes are mature, the skin should not peal when rubbed by hand
- Use fork for harvesting
- Do not harvest on wet conditions
- Harvest when all leaves have fully dried

7 WEEED YOUR PLOT AND HILL REGULARLY

- From 10 to 15 cm plant height start hilling. Do not cover more than half of the plant when hilling. Hill by moving soil from the ridge to the furrow where potatoes are growing.
- Ensure that soil is not too dry or not too wet when you hill
- Plants should be fully hilled when they reach 30 cm height
- Remove weeds during hilling

IMPORTANT CONSIDERATION

Farmers are not encouraged to use previous crop as seed

GUIDE FOR PEST CONTROL IN POTATOES

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Cutworm	Cuts off stems of young plants during stand establishment. Later in the season, they feed on plants leaves		Spray with one of the following a day or a week before planting - Decis - Malasol - Cypermethrine Control weeds before planting	Decis – 5 ml Malasol – 35 ml Cypermethrine – 5 ml	Decis – 2 days Malasol – 7 days Cypermethrine – 7 days
2	Aphids	Suck juices from young plant leaves. This may result in stunted growth and deformed leaves. Aphids also spread viruses to plant		Spray with the following when seen: - Aphicide Scout regularly from flowering until harvesting	Aphicide	Aphicide
3	Potato tuber moth	Larvae bore into tubers. Larvae may also feed on young leaves and stems		Apply one of the following at first sign of moths and repeat at 2 week intervals - Decis - Malasol Do not leave harvested tubers in the field over night Clean up crop remains after harvesting	Decis – 5 ml Malasol – 35 ml	Decis – 2 days Malasol – 7 days
4	Red spider mite	Sucks plants leading to defoliation		Spray with agromectin / profenofos	Profenofos – 100ml agromectin – 15ml	Profenofos – 4 days agromectin – 3 days
5	Leaf miner	Larvae mines leaves		Spray with agromectin at appearance	Agromectin – 15ml	Agromectin – 3 days
6	Millipede	Millipedes tunnel into potato tubers		Apply curatter as a row treatment at planting		
7	Mole	Eats tubers		Erect posts with crosses in garden to attract predator birds Apply curatter as a row treatment at planting or before planting		

NBNV

GUIDE FOR DISEASE CONTROL IN POTATOES

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Early blight	Causes round dark brown injuries on leaves with yellow colour surrounding wounds. Wounds may lead to leaves dying. Infected tubers develop round dark sunken injuries		Plant healthy seed Irrigate and fertilize well to maintain strong healthy plants Spray with Ridomil or a mixture of copper and Dithane M45 before flowering at week intervals After flowering use a mixture of copper and Dithane M45 or spray with Bravo	Dithane – 40g Bravo – 30ml Ridomil – 100g Copper oxychloride – 100g	Dithane – 0 days Bravo – 3 days Ridomil – 14 days Copper oxychloride – 14 days
2	Late blight	Affects leaves and stems. Causes small, light green circular to irregular water soaked spots on leaves. Lesions grow and develop into dark spots. Dark grey to lesions develop on stems	 	Plant healthy seed Irrigate and fertilize well to maintain strong healthy plants Use mixture of copper and dithane or ridomil before flowering After flowering, spray with Bravo	Bravo – 30ml Ridomil – 100g Copper oxychloride – 100g Dithane M45 – 40g	Bravo – 3 days Ridomil – 14 days Copper oxychloride – 14 days Dithane M45 – 0 days
3	Bacterial wilt	Causes wilting of plants even when the soil is moist. Only one or two stems of the plant show wilting at first, but later entire plants wilts and dies. Affected tubers show a brown ring when cut through. Small brown circle develops under skin		Plant only certified seed potatoes. Do not plant in fields with a history of bacterial wilt infection Remove infected plants and destroy them		

POTATO SPRAY PROGRAM

Time of application from emergence	Name of pesticide	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting	Purpose of pesticide
AT PLANTING	Curaterr			To control nematodes / Millipedes
	Decis Forte	5 ml	2 days	To control aphids and tuber moth
WEEK 1	Copper oxychloride	100 g	14 days	To control early blight and late blight
	Agromectin	15 ml	3 days	To control aphids, tuber moth and cutworms
	Curaterr			To control millipedes
	Mesurol			To control snails
WEEK 2	Bravo	30ml	3 days	To control early blight and late blight
	Decis Forte	5 ml	2 days	To control aphids, tuber moth and cutworms
	Curaterr			To control millipedes
	Mesurol			To control snails
WEEEK 3	Copper oxychloride	100 g	14 days	To control early blight and late blight
	Agromectin	15 ml	3 days	To control aphids, tuber moth and cutworms
	Curaterr			To control millipedes
	Mesurol			To control snails
WEEEK 4	Bravo	30ml	3 days	To control early blight and late blight
	Decis Forte	5 ml	2 days	To control aphids, tuber moth
WEEEK 5	Copper oxychloride	100 g	14 days	To control early blight and late blight
	Agromectin	15 ml	3 days	To control aphids, tuber moth
WEEEK 6	Bravo	30ml	3 days	To control early blight and late blight
	Decis Forte	5 ml	2 days	To control aphids, tuber moth
WEEEK 7	Copper oxychloride	100 g	14 days	To control early blight and late blight
	Agromectin	15 ml	3 days	To control aphids, tuber moth
WEEEK 8	Bravo	30ml	3 days	To control early blight and late blight
	Decis Forte	5 ml	2 days	To control aphids, tuber moth
WEEEK 9	Copper oxychloride	100 g	14 days	To control early blight and late blight
	Agromectin	15 ml	3 days	To control aphids, tuber moth
WEEEK 10	Bravo	30ml	3 days	To control early blight and late blight
	Decis Forte	5 ml	2 days	To control aphids, tuber moth
WEEEK 11	Copper oxychloride	100 g	14 days	To control early blight and late blight

	Agromectin	15 ml	3 days	To control aphids, tuber moth
WEEEK 12	Bravo	30ml	3 days	To control early blight and late blight
WEEEK 13	Copper oxychloride	100 g	14 days	To control early blight and late blight

PHYSIOLOGICAL DISORDERS IN POTATOES

	Name of physiological disorder	**What are the symptoms of physiological disorder**	**Picture of physiological disorder**	**How can it be avoided or corrected**
1	Hollow heart	This is an internal non infectious disorder of the potato tuber. Brown center is characterised by a region of cell death in the pith of the tuber that results in brown tissue This is usually caused by improper watering of potatoes		Make sure that potatoes are irrigated properly and uniformly. Follow the recommended spacing by not planting potatoes too far apart Avoid applying excessive organic matter high in nitrogen Conduct soil test and follow recommended fertilizers and quantities to be applied
2	Deformation	Deformations are primarily due to high temperature stress in the field. They are often exacerbated by water stress. However, water stress alone does not cause these deformations. The severity of the deformations increases with higher temperatures and longer high-temperature periods.	 	When planting susceptible varieties choose areas with cooler climates. Irrigate adequately during early bulking. Field capacity should be maintained during tuber growth stage
3	Growth cracks	Growth cracks occur due to uneven availability of soil moisture and rapid, uneven uptake of water. This occurs when heavy rain or excessive short-term irrigation is followed by a period of dryness. Growth cracking is worsened when plants are spaced widely apart or when tuber set is unusually low. Uneven fertilization placement worsens the cracking. This is also true of excessive nitrogen or poor timing of nitrogen fertilization especially during the mid-bulking		Plant using a uniform plant spacing Maintain adequate soil moisture with consistent irrigation scheduling Fertilize uniformly Avoid excessive and late applications of nitrogen.

		period. Low soil boron may also worsen the amount of cracking.		

GUIDE FOR GROWING BUTTERNUT

VARIETIES

- **Grow varieties that are wanted by your market**
- **Common varieties are Waltham, pilgrim, canesi, atlas**

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

- Summer: all region are suitable for butternut
- Winter: suitable only in the Lowveld and Dry Middleveld

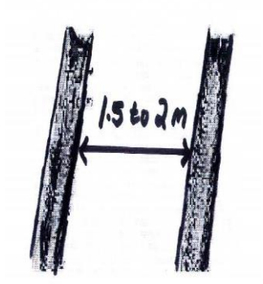
(See appendix 1 for more information on planting calendar)

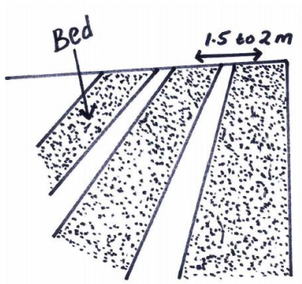
1 PLOUGH YOUR LAND

- Plough your field at least 2 weeks before planting
- Field should be harrowed

2 OPEN PLANTING LINES

- Planting system will depend on soil type and irrigation system to be used
- Open planting lines or ridges with a spacing of 2m



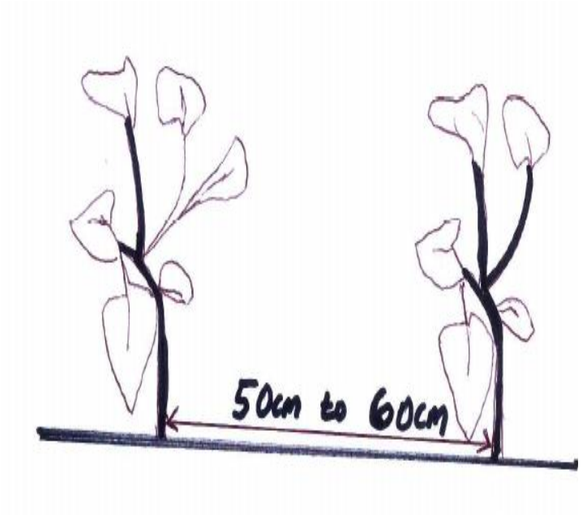


3 APPLY BASAL FERTILIZER

- Always test your soil to know how much fertilizer to apply
- Apply recommended fertilizer on planting lines before planting

4 PLANT

- Plant using a spacing between plants of 50cm to 60cm
- Plant population should be 11000 to 12000 plants per hectare
- Irrigate after planting
- Control rodents during planting by properly covering seeds, using rodent baits and observing good sanitation
- Seedlings can also be prepared in trays to avoid rats especially in winter where seeds rarely germinate in the field



5 IRRIGATE YOUR CROP

- Any irrigation system can be used. Overhead irrigation is the most recommended
- As the frequency of irrigation varies with soil type, farmer is encouraged to know his soil
  - Planting to crop establishment: Irrigate more frequently
  - Vegetative stage: irrigate regularly
  - Flowering to maturity : Irrigate regularly
  - Do not wait for soil to be dry before irrigating, keep it moist

7 APPLY TOP DRESSING FERTILIZER

- Weed first before applying any top dressing fertilizer
- Fertilizer should be applied based on recommendations of a soil analysis
- Apply recommended top dressing fertilizer 2 weeks after planting
- Repeat application 4 weeks after planting
- Farmer should ensure that recommended amount has been applied at the completion of split applications

6 WEEED YOUR PLOT

- If preferring chemical weeding, apply a suitable herbicide before planting and observe number of days you have to wait before planting
- While crop is growing, apply a suitable selective herbicide to kill weeds
- Do regular manual weeding if not using herbicides to keep plot clean
- If implements are available weed mechanically without causing injury to plants
- Keep plot free of weeds

9 HARVEST

- Harvest after 3 to 4 months depending on cultivar and size of fruits wanted by market. Follow days stipulated on variety package
- Use sharp knife to cut fruit from plant. Do not break stem off as this might provide entry for post harvest pathogens
- At maturity, skin colour should be fully yellow and should not easily peel when scratched
- Store in a cool area after harvest or under shade

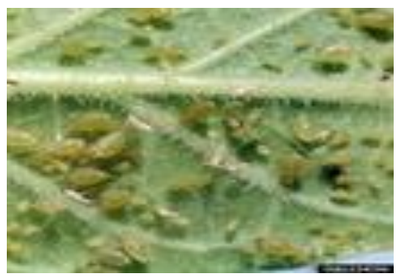
8 CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Contact nearest extension officer for advice
- Control pests and diseases by using recommended pesticides
- See next page for more details on pest and disease control

1 AFTER HARVEST

- Keep fruits dry and without injuries
- Should not be kept at a temperature below 15˚C

GUIDE FOR PEST CONTROL BUTTERNUT

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Rodents	Destroy seeds before germination		Use baits and keep fields clean Use seedlings if there is a high rodent infestation Plant sprouted seeds (pre-germination)		
2	Fruit fly	Adult flies lay eggs in young fruit and maggots develop inside. The maggots feed on the butternut inside causing it to decay		Spray with GF 120 or hamba fruit fly. Repeat application at 2 week intervals Also spray underside of leaves as fruit flies tend to hide there	GF 120 – 700ml Hamba Fruit Fly	GF 120 – 1 day Hamba Fruit Fly
3	Aphids	Aphids suck plant juices from tender plants resulting in culled leaves and stunted plants.		Spray with Decis Forte or cypermethrin or use aphicide at first sign of appearance – repeat application every 10 days	Decis Forte – 5ml Cypermethrin – 5 ml Aphicide	Decis Forte – 2 days Cypermethrin – 4 days Aphicide
4	Cutworm	Destroy young seedlings		Spray with decis or cypemethrin or apply cutworm bait at planting Or Spray with pesticides or spray with pesticides at first sign of occurrence preferably in the evening	Decis – 5 ml Cutoworm bait Cypemethrin – 5 ml	Decis – 7 days Cutoworm bait Cypemethrin – 4 days

GUIDE FOR DISEASE CONTROL IN BUTTERNUT

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Powdery mildew	Causes white powder to appear on lower surface of leaves. White spots later form on upper surface of leaves. Infected leaves turn brown and die		Spray with bravo or a mixture of copper oxychloride and dithane at first sign of disease. Repeat at 2 week intervals Practice crop rotation	Bravo – 50 ml Copper oxychloride – 60 g Dithane – 40G	Bravo – 3 days Copper oxychloride – 3 days Dithane – 7ays
2	Downey mildew	Causes yellow spots to appear on the upper surface of leaves and a purplish mildew on the lower surface side. The affected plant will not continue to flower and the developed fruit will not reach maturity		Control movement of disease from infested to non infested fields. Use rainsuits when working in fields as they are easy to wash Spray with ridomil or bravo or a mixture of copper oxychoride and dithane. Repeat at 2 week intervals	Ridomil – 100g Copper oxychlroride – 60 g Dithane – 40G Bravo – 40 ml	Ridomil – 7 days Copper oxychlroride – 3 days Dithane – 7ays Bravo – 3 days
3	Mosaic Virus	Leaves on older plants distorted, wrinkled, and edges curled downwards. Fruits have irregular pale green or white areas scattered with dark green spots.	 	Remove all infected plants and then burry or burn them in an isolated place Use insecticides like Decis or cypermethrin to control vectors like aphids and thrips through a spray program to minimize the spread of the disease	Decis – 5ml Cypermetrin – 5ml	Decis – 7 days Cypermetrin – 4 days

BUTTERNUT SPRAY PROGRAM

Time of application from emergence	Name of pesticide	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting	Purpose of pesticide
WEEK 2	Ridomil / Copper oxychloride	Ridomil (100g) / Copper oxychloride (60g)	Ridomil (7 days) / Copper oxychloride (3 days)	For control of powdery mildew
WEEK 3	Bravo	Bravo (20ml)	Bravo (3 days)	For control of powdery and downey mildew and anthracnose
WEEK 4	Ridomil / Copper oxychloride	Ridomil (100g) / Copper oxychloride (60g)	Ridomil (7 days) / Copper oxychloride (3 days)	For control of powdery mildew
WEEK 5	Bravo	Bravo (20ml)	Bravo (3 days)	For control of powdery and downey mildew and anthracnose
WEEK 6	Ridomil / Copper oxychloride	Ridomil (100g) / Copper oxychloride (60g)	Ridomil (7 days) / Copper oxychloride (3 days)	For control of powdery mildew
	GF 120	GF 120 (700ml)	GF 120 (1 day)	For control of fruit fly
WEEK 7	Bravo	Bravo (20ml)	Bravo (3 days)	For control of powdery and downey mildew and anthracnose
WEEK 8	Ridomil / Copper oxychloride	Ridomil (100g) / Copper oxychloride (60g)	Ridomil (7 days) / Copper oxychloride (3 days)	For control of powdery mildew
	GF 120	GF 120 (700ml)	GF 120 (1 day)	For control of fruit fly
WEEK 9	Bravo	Bravo (20ml)	Bravo (3 days)	For control of powdery and downey mildew and anthracnose
WEEK 10	Copper oxychloride	Copper oxychloride (60g)	Copper oxychloride (3 days)	For control of powdery mildew
	GF 120	GF 120 (700ml)	GF 120 (1 day)	For control of fruit fly
WEEK 11	Bravo	Bravo (20ml)	Bravo (3 days)	For control of powdery and downey mildew and anthracnose
WEEK 12	Copper oxychloride	Copper oxychloride (60g)	Copper oxychloride (3 days)	For control of powdery mildew
	GF 120	GF 120 (700ml)	GF 120 (1 day)	For control of fruit fly
WEEK 13	Bravo	Bravo (20ml)	Bravo (3 days)	For control of powdery and downey mildew and anthracnose

WEEK 14	Copper oxychloride	Copper oxychloride (60g)	Copper oxychloride (3 days)	For control of powdery mildew
	GF 120	GF 120 (700ml)	GF 120 (1 day)	For control of fruit fly

PHYSIOLOGICAL DISORDERS IN BUTTERNUT

	Name of physiological disorder	**What are the symptoms of physiological disorder**	**Picture of physiological disorder**	**How can it be avoided or corrected**
1	Fruit cracking	It is caused by too much irrigation which follows a dry spell (lack of irrigation) during the period of ripening of the fruit		Maintain uniform irrigation during the fruit ripening stage

GUIDE FOR GROWING ONIONS

VARIETIES

- **Grow varieties that are wanted by your market**
- **Common varieties are Texas grano, pyramid, hojem and Australian Brown**

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

Best time

- **Highveld: February to March**
- **Middleveld: February to March**
- **Lowveld: March to April**

Suitable time

- **Highveld: September to November; January, April**
- **Middleveld: September to November; January, April**
- **Lowveld: February, May, June, September, October**

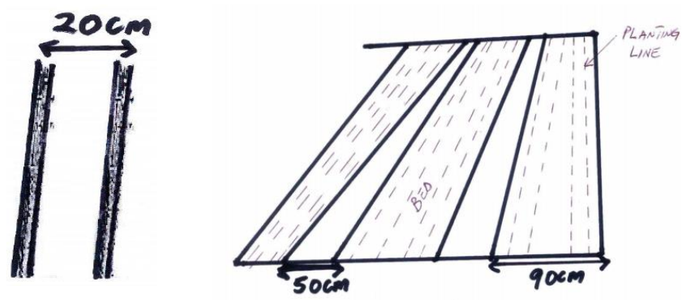
(See appendix 1 for more information on planting calendar)

1 PLOUGH YOUR LAND

- Plough deeply using a disc plough
- Harrow to prepare a fine tilth

2 OPEN PLANTING LINES

- Open single rows with a spacing of 20cm to 40 cm
- When using double rows, construct rows that are 30cm apart
- The spacing between planting lines in a double row bed should be 20cm
- The length of beds and planting lines should be 20 metres

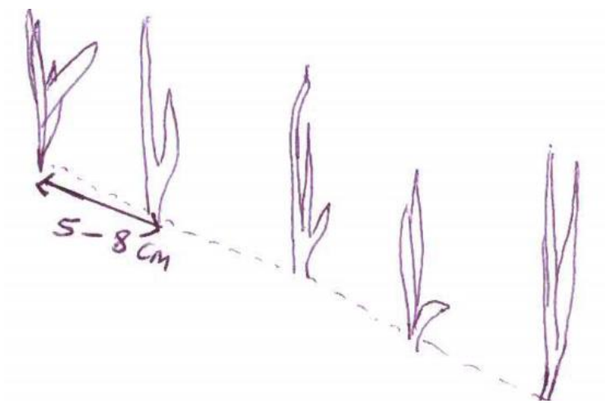


3 APPLY BASAL FERTILIZER

- Always test your soil to know how much fertilizer to apply
- Broadcast recommended fertilizer on whole bed or planting line
- Use rake to mix fertilizer with soil

5 PLANT

- Wet the soil before planting seedlings
- Plant late in the afternoon or when the weather is cloudy
- Plant using a spacing of 5 to 8 cm between plants
- For direct planting, 3 to 5 Kgs per hectare of seeds should be planted
- Mix seed with sand first when planting directly



6 IRRIGATE YOUR CROP

- Use any method for irrigation – furrow, sprinkler or drip irrigation
- As the frequency of irrigation varies with soil type, farmer is encouraged to know his soil
  - Week 1: Irrigate more frequently
  - Week 2: Irrigate more frequently
  - Week 3 onwards: Irrigate regurlary
  - Do not wait for soil to become dry before irrigating, keep it moist

8 APPLY TOP DRESSING FERTILIZER

- Weed first before applying any top dressing fertilizer
- Start by irrigating before applying top dressing fertilizer
- Fertilizer should be applied based on recommendations of a soil analysis
- Apply recommended top dressing fertilizer in staggered applications every 3 weeks until bulb formation. Stop fertilizer application once bulb are formed
- Ensure the fertilizer is broadcast between row and then cover with soil
- Farmer should ensure that recommended amount has been applied at the completion of split applications

7 WEEED YOUR PLOT

- Weed your crop regularly
- Do not earth up, bulbs and necks should be above the soil

1 HARVEST

- Prepare drying structure before harvesting takes place, structure should be well ventilated
- Harvest at maturity when 50 % of leaves have dried and necks have fallen over
- Stop irrigation a week before harvesting
- Loosen the soil using a fork and uproot bulbs
- Cut irrigation completely if onions have reached market size

9 CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Contact nearest extension officer for advice
- Control pests and diseases by using recommended pesticides
- See next page for more details on pest and disease control

1 AFTER HARVEST

- Use a drying structure to dry bulbs
- Store under cool and dry conditions
- Check bulbs regularly and discard any rotting, softening and sprouting onions
- Tops fall off on their own, do not cut or tear them. Cutting promotes rotting
- Pack onions of the same size and maturity
- Do not dry on floors, bulbs should be hanged

GUIDE FOR PEST CONTROL IN ONIONS

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Thrips	They suck juice from lower side of leaves. Leaves appear silvery with sunken areas that later dry resulting to weakened plants and reduced yield. Heavy feeding can kill young plants		Spray with Decis Forte or Malasol when pest is noticed. Repeat 14 days later Destroy crop residues after harvest	Decis Forte – 5ml Malasol – 35 ml	Decis Forte – 2 days Malasol – 7 days
2	Army worm	They bore into onion leaves and feed leaving the outside of leaf almost intact.		Spray with Fastac or Dipel	Fastac – 10ml Dipel – 20 g	Fastac – 21 days Dipel
3	Cutworm	Cut off plants near the surface of the soil	 	Spray with Decis Forte or cutworm bait at planting	Decis Forte – 5 ml Cutworm bait	Decis Forte – 2 days Cutworm bait

GUIDE FOR DISEASE CONTROL IN ONIONS

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Downy Mildew	Causes yellowing of leaves which eventually collapse and die	 	Spray program: Dithane and copper oxychloride Control: Use Ridomil or Binomil or Bravo	Dithane – 40g Copper oxychloride – 60 g Ridomil – 40g Bravo – 40 m Binomil	Dithane – 14 days Copper oxycloride – 3 days Ridomil – 7 days Bravo – 3 days Binomil
2	Purple blotch	Small water-soaked areas on leaves turn brown , then purple with yellow centres	 	Rotate to none related crops Spray program: Dithane and copper oxychloride Control: Use Ridomil or Bravo	Dithane – 40g Copper oxychloride – 60g Ridomil – 40g Bravo – 40 ml	Dithane – 14 days Copper oxychloride – 3 days Ridiomil – 7 days Bravo – 3 days
3	Black mould	Occurs between dry and dead outer scales and the first inner scales of the bulb. Invaded scales first become water-soaked, under dry conditions disease scales dry and shrivel		Spray program: Dithane and copper oxychloride Control: Use Redomil or Binomil or Bravo	Dithane – 40g Copper oxychloride – 60g Ridomil – 40g Bravo – 40 ml	Dithane – 14 days Copper oxychloride – 3 days Ridomil – 7 days Bravo – 3 days
4	Soft rot	Centre of leaves become pale and collapse. Infected inner scales of bulbs become water soaked and later become yellow or pale brown.	 	Spray with with Xanbac Avoid sprinkler irrigation once onions start to form bulbs	Xanbac – 50 ml	Xanbac – 3 days

ONION SPRAY PROGRAM

Time of application after transplanting	Name of pesticide	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting	Purpose of pesticide
AT TRANSPLANTING	Decis Forte	5ml	3 days	To control cutworm
	Nematicide / Curaterr	Nematicide / Curaterr	Nematicide or Curator	To control nematodes
WEEK 4	Dithane M45	40 g	14 days	To control downy mildew, purple blotch
	Malasol	35 ml	7 days	To control thrips
WEEK 5	Bravo	40 ml	3 days	To control downy mildew, purple blotch
	Decis Forte	5 ml	3 days	To control thrips
WEEK 6	Dithane M45	40 g	14 days	To control downy mildew, purple blotch
	Malasol	35 ml	7 days	To control thrips
WEEK 7	Bravo	40 ml	3 days	To control downy mildew, purple blotch
	Decis Forte	5 ml	3 days	To control thrips
WEEK 8	Dithane M45	40 g	14 days	To control downy mildew, purple blotch
	Malasol	35 ml	7 days	To control thrips
WEEK 10	Bravo	40 ml	3 days	To control downy mildew, purple blotch
	Decis Forte	5 ml	3 days	To control thrips
If there is evidence of pest or disease after week 10, spray with a dithane M45 and malasol. Alternate with Bravo and decis				
Note: Do not use dithane on spring onions, use bravo instead				

GUIDE FOR GROWING BEETROOT

VARIETIES

- **Grow varieties that are wanted by your market**
- **Common varieties are: Globe dark red, Red atlas, star 1105, lorrette, Rudolf**

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

Summer : Globe dark red, red atlas, star 1105, Rudolf

- **Winter: lourete**
- **Beetroot can be planted throughout the year in the highveld and middleveld and only in winter in the Lowveld**

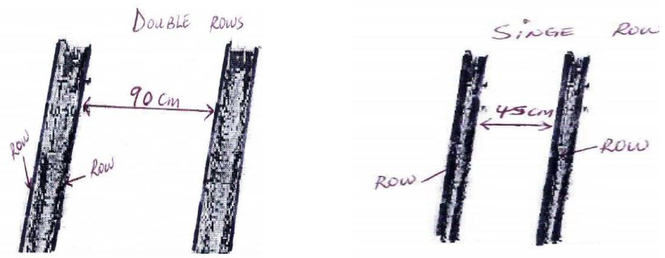
(See appendix 1 for more information on planting calendar)

1 PLOUGH YOUR LAND

- Plough your field to a depth of 15 to 20 cm to break clods
- Prepare a fine tilth by harrowing

2 OPEN PLANTING LINES

- Open single planting lines using a spacing of 45 cm between lines
- If using double rows, the spacing between double rows should be 90cm and spacing between lines in each double row should be



3 APPLY BASAL FERTILIZER

- Always test your soil to know how much fertilizer to apply
- Broadcast recommended fertilizer on whole planting line or beds before planting

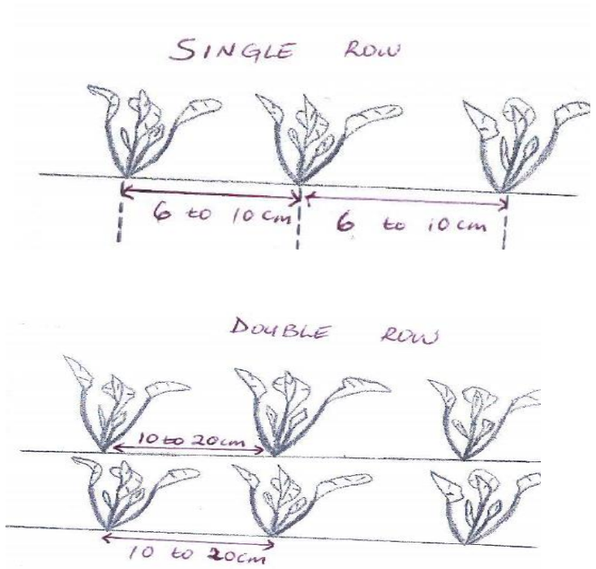
5 PLANT

If planting directly

- On single rows: spacing between plants should be 6 to 10cm
- Irrigate after planting

If using seedlings

- Soak your seedlings over night
- Irrigate before planting preferably the day before
- For double rows: plant seedlings using a spacing of 10 to 20cm between plants
- If using single row: plant using a spacing of 6 to 10 cm between plants



6 IRRIGATE YOUR CROP

- Never allow soil to become too dry and it should not be too moist
- Any irrigation method can be used
- As the frequency of irrigation varies with soil type, farmer is encouraged to know his soil
  - Week 1 to bulb formation: Irrigate more frequently
  - Bulb formation: irrigate more frequently
- In case of furrow irrigation, mulch irrigation furrow to avoid erosion

8 APPLY TOP DRESSING FERTILIZER

- Weed your field first before applying fertilizer
- Always refer to results of a soil test for recommendations of top dressing fertilizer
- Broadcast recommended fertilizer at 4 weeks after transplanting

7 WEEED YOUR PLOT

- Weed your crop regularly
- Use hand fork or hoe to weed your plot
- Thinning to recommended plant spacing should be done if planting was done directly
- If using chemicals, a pre-emergence herbicide can be applied 3 weeks before planting
- Farmer is encouraged to seek advice from technical advisor or input supplier before using herbicides in his fields

1 HARVEST

- Harvest when roots are 5 to 10 cm in diameter depending on market specifications
- Always adhere to market specifications on sizes
- Check information on maturity days for the different varieties

9 CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Contact nearest extension officer for advice
- Control pests and diseases by using recommended pesticides
- See next page for more details on pest and disease control

1 AFTER HARVEST

- Sort and grade your vegetable. All beetroot which are diseased and those showing mechanical injury should be removed
- Damaged leaves should be removed if beetroot will be sold with leaves
- Use soft brushing when washing
- Rinse with clean water and a spore killing chemical

GUIDE FOR PEST CONTROL IN BEETROOT

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Aphids	They suck juices on lower surface of leaves. If aphids are many, they may result in stunting. Infected leaves are curly and rolled		Practise crop rotation Spray with Aphicide only when aphids are noticed Remove weeds on edges of field	Aphicide – 20 g	Aphicide
2	Red spider mite	They suck plant juices on lower surface of leaves.		Spray with Agromectin	Agromectin – 12 ml	Agromectin – 3 days
3	American Bollworm	Feeds on roots		Spray with Cypermethrin or Decis Forte and repeat after 7 to 10 days	Decis Forte – 5 ml Cypermethrin – 5 ml	Decis Forte – 2 days Cypermethrin – 4 days

GUIDE FOR DISEASE CONTROL IN BEETROOT

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Leaf spot	Small round brown spots appear on leaves with reddish-purple borders and later turn grey in the center. The tissue in the center falls as the spots become old.		Spray with a mixture of copper oxychloride and dithane or spray with bravo Follow a 2 to 3 year rotation cycle away from beetroot and other related crops	Copper oxychloride – 60g Dithane – 40g Bravo – 40ml	Copper oxychloride – 3 days Dithane – 7 days Bravo – 3 days
2	Brown rust	Cause large numbers of orange or red-brown postules on leaves.	 	Control measures are not necessary since the disease rarely cause any damage	Copper oxychloride – 60 g Dithane – 40g	Copper oxychloride – 3 days Dithane – 7 days

GUIDE FOR GROWING CARROTS

VARIETIES

- **Grow varieties that are wanted by your market**
- **Common varieties are: Major, scarlet and nantes (winter variety)**

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

Highveld: February to October
- **Middleveld: March to August**
- **Lowveld: March to June**

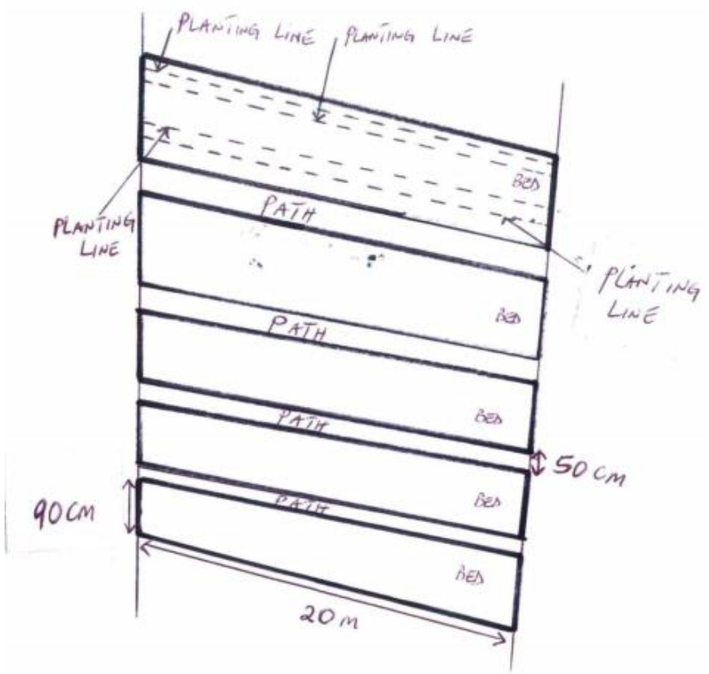
(See appendix 1 for more information on planting calendar)

1 PLOUGH YOUR LAND

- Remove crop residues from the field. If you decide to bury crop residues, wait for 8 weeks until they decompose
- Do not grow carrots on land that had maize as a previous crop
- Plough deeply to a depth of at least 30cm
- Harrow to prepare a fine tilth
- Fumigate soil to control nematodes

2 OPEN PLANTING LINES

- Prepare beds with a width of 50cm
- Beds should not be more than 20 metres long
- Open 2 rows on edges of each bed 45 cm apart
- Leave a space of 50cm between beds as a pathway



3 APPLY BASAL FERTILIZER

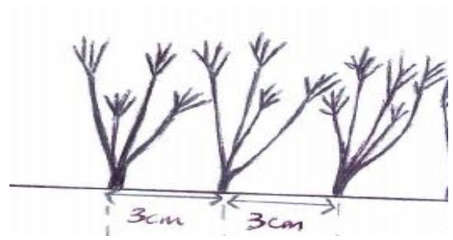
- Always test your soil to know how much fertilizer to apply
- Broadcast recommended fertilizer on whole bed before planting
- Use rake to mix fertilizer with soil
- Water bed to dissolve fertilizer
- Do not apply compost or organic matter as it causes hairy roots

4 PLANT

- Apply a selective herbicide before planting to control weeds
- Seek advice from technical advisor or Input supplier on use of herbicides
- If using a planter, planting depth will be determined by the machine
- Always mix seed with sand when planting with hand
- Plant to a depth of 1 to 2.5 cm. In sandy soils the planting depth should be 4 cm

5 THIN

- Thin plants 3 to 4 weeks after germination
- Thinning should be done when the soil is moist
- Final stand should have a spacing of 3cm between plants



6 IRRIGATE YOUR CROP

- As the frequency of irrigation varies with soil type, farmer is encouraged to know his soil
  - Irrigate more frequently from planting up to 4 weeks after planting
  - Irrigate regularly after thinning
  - Never allow soil to dry out
  - Do not irrigate too much as this leads to short carrots
  - Reduce irrigation when the carrots approach maturity

7 WEEED YOUR PLOT

- Use hand fork or hoe to weed your plot
- Always keep your plot free from weeds

CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Contact nearest extension officer for advice
- Control pests and diseases by using recommended pesticides
- See next page for more details on pest and disease control

8 APPLY TOP DRESSING FERTILIZER

- Weed your field first before applying fertilizer
- Always refer to results of a soil test for recommendations on top dressing fertilizer
- Broadcast recommended top dressing fertilizer 4 weeks after germination
- Ensure that recommended amount is fully applied

1 HARVEST

- Always adhere to the requirements of each market for specific sizes when harvesting
- Irrigate a day before harvesting
- Uproot and bite carrot to determine if it has reached maturity – if carrot has accumulated sugar, it means they have reached maturity
- Use fork to harvest roots

1 AFTER HARVEST

- Place carrots in crates. Keep carrots under shade before washing them
- Wash carrots carefully and avoid damage to the roots
- Pack carrots in air tight plastic bags

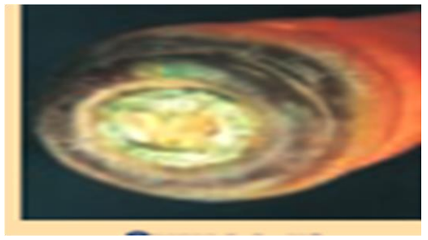
GUIDE FOR PEST CONTROL IN CARROTS

	Name of pest	**What impact does it have on plants**	**Picture of damage caused by pest**	**How can it be it be controlled**	**How much pesticide should be mixed in 20L knapsack**	**How many days should be waited before harvesting**
1	Aphids	They suck juices from the plant resulting in stunted growth		Spray with malasol or agromectin at first sign of pest infestation Remove weeds on edges of field	Agromectin – 12 ml Malasol – 35 ml	Agromectin – 7 days Malasol – 7 days
2	Leaf miners	Larvae mines leaves		Spray with cypermethrin or Decis Forte at first sign of infestation. Repeat at after 7 days to maintain control. Another option would to spray with Karate or Dipel	cypermethrin – 5 ml Decis Forte – 5 ml Karate – 2 ml Dipel – 10g	Abametrin – 4 days Decis Forte –7 days Karate – 14 days Dipel

GUIDE FOR DISEASE CONTROL IN CARROTS

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Soft rot	In very poorly drained soils, tip rot occurs in the field. Soft rots are characterised by a watery, smelly decay		Avoid late top dressing Use resistant varieties Plant on raised beds in poorly drained soils Avoid injuring roots during weeding Practice crop rotation – rotate to non root crops		
2	Sclerotina rot	Early signs of the disease are water soaked spots at the base of the foliage. If humidity is high, the infection is accompanied by a cottony white growth on the carrots	 	Do not plant in poorly drained soils Avoid low plant densities Infected fields should be planted with non susceptible crops for 3 years Weed plot to improve air movement within the crop canopy		
3	Root Knot	Causes damage to roots which results in forked, distorted and stunted tap root		Soil should be fumigated before planting Practise crop rotation Leave land fallow in summer to reduce nematode numbers – fallow land should be weed free		

PHYSiOLOGICAL DISORDERS IN CARROTS

	Name of physiological disorder	What are the symptoms of physiological disorder	Picture of physiological disorder	How can it be avoided or corrected
1	Shrivelled carrots	Shrivelling is caused by lack of moisture after harvest. Reasons for this include: - harvest in hot conditions - delay in transporting carrots to storage, - Failure to quickly cool the carrots once in storage.		Store carrots in a cool place (shade) after harvest Do not keep carrots for a long time after harvest before transporting them to the market Cool carrots as soon as they are harvested to ensure they store well
2	Greening	Green colour occurs at the top shoulders of carrots due to exposure to sunlight. Greening tends to be a problem in light soils prone to wind or water erosion and when carrots are planted in raised beds.		Hilling carrots during the season will help to control greening. Thick stands create enough shade to protect the roots from the sun.
3	Misshappen roots	Can be caused by a number of factors such as: hardpan, cultivars, compacted soil and over-irrigation. Hardpans prevent the root from growing straight down. Untimely or uneven precipitation causes the root not to grow straight.		Plough soil deeply prior to planting Ensure a finely worked seedbed by harrowing Avoid planting carrots in heavier soils If you have heavier soils, the use of raised beds may reduce misshappen roots
4	Forked roots	There are several causes of forked carrots: - Compacted soil - Too much water - Heavy fertilization - Close spacing		Ensure soil is not dry by irrigating uniformly. Avoid over watering Always apply fertilizer based on recommendations of a soil test Plough soils deeply Do not use compost Ensure that root tip is not damaged
4	Hairy roots	Hairy roots are caused by too much irrigation of carrots		Avoid too much irrigation

GUIDE FOR GROWING CABBAGES

VARIETIES

- Know which varieties your market wants
- Common varieties are: conquistador, tenacity, Hercules, star 3301

SUITABLE PLANTING TIMES FOR THE DIFFERENT REGIONS IN THE COUNTRY

- Can be planted throughout the year in the Highveld and middleveld as long as cultivar suitable for season is used
- Plant only in winter in the Lowveld

(See appendix 1 for more information on planting calendar)

1 PLOUGH YOUR LAND

- Plough your land deeply 2 weeks before planting
- Prepare a fine tilth before planting
- Fumigate soil 2 weeks before planting

2 OPEN PLANTING LINES

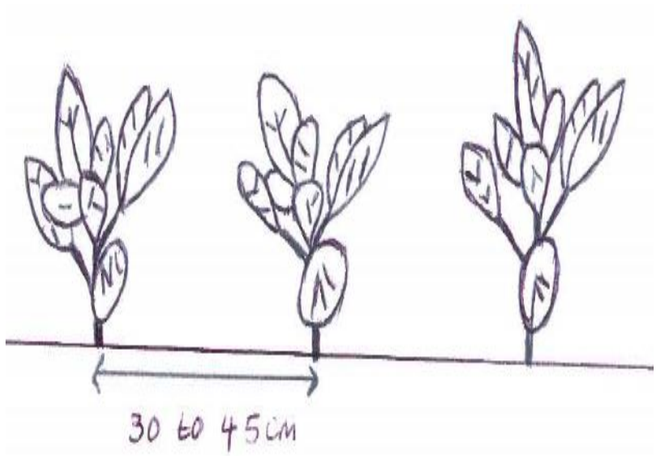
- Open planting lines using a spacing of 90 cm between rows

3 APPLY BASAL FERTILIZER

- Always test your soil to know how much fertilizer to apply
- Apply recommended fertilizer per planting station and mix with soil before planting

5 PLANT

- Irrigate before transplanting seedlings
- Spray with decis or malasol or use cutworm bait on planting lines to control cutworm. This should be done before planting
- Plant late in the afternoon or when the weather is cloudy
- Plant using a spacing of 30 to 45 cm between plants
- Plant seedlings vertically into the the soil. This helps in avoiding J-rooting



6 IRRIGATE YOUR CROP

- Use any method for irrigation – furrow, sprinkler or drip irrigation
- As the frequency of irrigation depends on soil type, farmer is encouraged to know his soil
  - Week 1: Irrigate more frequently
  - Week 2 onwards: Irrigate more frequently
  - During head formation: Irrigate regularly
  - At maturity: irrigate regularly
  - Do not allow your soil to become too dry before deciding to irrigate

8 APPLY TOP DRESSING FERTILIZER

- Weed your field first before applying fertilizer
- Apply recommended top dressing fertilizer as a band 5 to 10 cm away from plant on the following weeks: Week 3, Week 6 and Week 9
- Ensure that recommended amount of fertilizer is fully applied at the completion of split applications

7 WEEED YOUR PLOT

- Apply a suitable herbicide before planting and observe number of days you have to wait before planting
- Always seek advice from technical advisor or input supplier before using herbicides
- Do spot hand weeding regularly to keep your plot clean

1 HARVEST

- Depending on variety, harvest 75 to 90 days after planting
- Harvest cabbage heads when they are firm
- Cut cabbage straight above below the head leaving 1 to 2 cm of root stalk
- Depending on market specifications, a certain number of wrapper leaves can be left on harvested cabbages when they are sold loose. Wrapper leaves act as protection during transportation
- If cabbages are bagged, there is no need to leave wrapper leaves
- Remove cabbage stumps from the field after harvesting – this helps in avoiding contamination through pests or insects

9 CONTROL PESTS AND DISEASES

- Scout your fields to identify pests
- Contact nearest extension officer for advice
- Control pests and diseases by using recommended pesticides
- See next page for more details on pest and disease control

11 AFTER HARVEST

- Depending on market requirements, cabbaged can be sold as loose heads or packed in green bags

GUIDE FOR PEST CONTROL IN CABBAGES

	Name of pest	What impact does it have on plants	Picture of damage caused by pest	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Cutworm	Cut off the stems of young seedlings close to ground level		Use cutworm bait or spray with Decis Forte or Cypermetrin	Cutworm bait – 450g per 20 by 15 m plot. Decis Forte – 5 ml Cypemetrin – 5 ml	Cutworm bait – 3 days Decis Forte – 3 days Cypemetrin
2	Diamond Back Moth	Feeds on leaves creating holes. May also feed on developing heads leading to head deformation		Spray with Malasol or Decis Forte or cypermethrin	Malasol – 50 ml Decis Forte – 5 ml Cypermethrin –5 ml	Malasol – 7 days Decis Forte – 3 days Cypermethrin
3	Aphids	Large number of aphids may kill small plants, stunt growth and transmit viral diseases. They also contaminate cabbages making them unmarketable		Spray with Aphicide from week 1 after transplanting and adhere to a weekly spray program Another option would be to spray with Profenols in a weekly programme	Aphicide – 40 g Profenols – 100 ml	Aphicide Profenols
4	Nematodes	Plants become stunted and may show signs of moisture or nutrient stress.	 	Can be controlled through crop rotation Use resistant cultivars Apply curaterr / nematicide as row treatment at planting or before planting	Curaterr Nematicide	Curaterr Nematicide

GUIDE FOR DISEASE CONTROL IN CABBAGES

	Name of disease	What impact does it have on plants	Picture of disease	How can it be it be controlled	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting
1	Downy mildew	Causes a white growth to develop under leaves leading to the development of yellow spots on the upper side of leaves. Infected leaves on young plants drop and plants may die. On older plants, leaves turns yellow and papery in texture		Plant at the recommended plant spacing for variety, avoid overcrowding plants. Spray with Bravo or ridomil or funginex Practice proper irrigation	Bravo Ridomil Funginex	Bravo Ridomil Funginex
2	Black rot	Blackening of seedlings on the margins. Infected seedlings are stunted and yellow and eventually wilt and die. On older plants, veins darken and the mid rib of leaves turn black within the affected area. When cut, leave veins are black on the inside		Use resistant varieties Rotate to fields that have not been planted with cole crops in past 3 years Clean out and burn plant residues or plough down residues immediately after harvesting Control pests		
3	Club root	Infected plants are stunted, leaves wilt and become purple. Roots change into a mass of large, elongated or rounded swelling or clubs		Use certified seed Lime the soil Practice crop rotation Grow transplants in fumigated land		

CABBAGE SPRAY PROGRAM

Time of application after transplanting	Name of pesticide	How much pesticide should be mixed in 20L knapsack	How many days should be waited before harvesting	Purpose of pesticide
AT PLANTING	Decis Forte	5ml	3 days	To control cutworm
	Nematicide or Curator	Nematicide / Curaterr	Nematicide / Curaterr	To control nematodes
WEEK 2	Decis Forte	5ml	3 days	To control diamond back moth and American bollworm
WEEK 3	Copper oxychloride	40g	7 days	To control downy mildew
	Dithane M45	40g	7 days	To control black rot
	Malasol	50ml	1 day	To control diamond back moth
WEEK 4	Bravo	20ml	3 days	To control downy mildew
	Dithane M45	40g	7 days	To control black rot
	Agromectin	15 ml	3 days	To control red spider mites
	Decis Forte	5ml	3 days	To control diamond back moth and American bollworm
WEEK 5	Copper oxychloride	40g	7 days	To control downy mildew
	Dithane M45	40g	7 days	To control black rot
	Malasol	50ml	1 day	To control diamond back moth
WEEK 6	Bravo	20ml	3 days	To control downy mildew
	Dithane M45	40g	7 days	To control black rot
	Agromectin	15 ml	3 days	To control red spider mites
	Decis Forte	5ml	3 days	To control diamond back moth and American bollworm
WEEK 8	Malasol	50ml	1 day	To control diamond back moth and American bollworm
WEEK 10	Decis Forte	5ml	3 days	To control diamond back moth and American bollworm
WEEK 12	Malasol	Malasol (50ml)	Malasol (1 day)	To control diamond back moth and American bollworm
WEEK 14	Decis Forte	Decis Forte (5ml)	Decis Forte (3 days)	To control diamond back moth and American bollworm

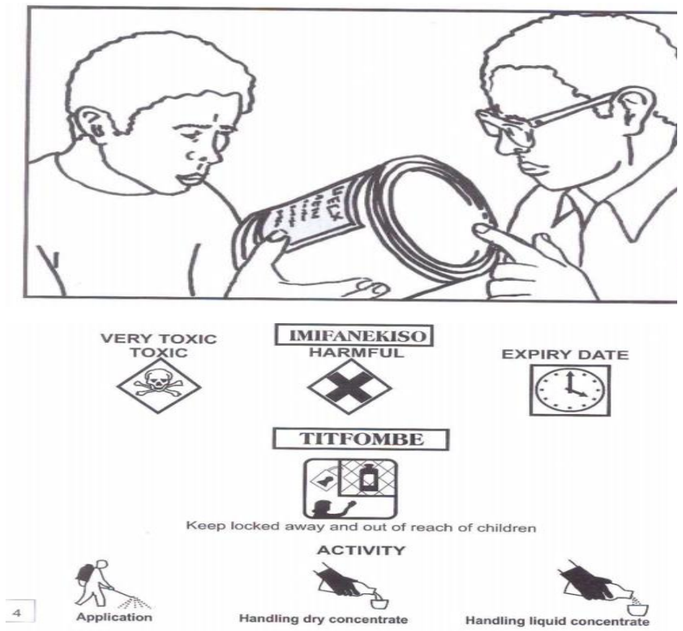
PHYSIOLOGICAL DISORDERS IN CABBAGES

	Name of physiological disorder	**What are the symptoms of physiological disorder**	**Picture of physiological disorder**	**How can it be avoided or corrected**
1	Splitting heads	Heads split or burst. This usually happens when a period of moisture stress is followed by heavy rain or too much irrigation. Delays in harvesting may also result in splitting heads.		Irrigate properly. Avoid too much irrigation Harvest cabbages on time Plant cultivars that are resistant to splitting
2	Black petiole	Black petiole is associated with poor fertility management It occurs in soils that are high in phosphorus levels and low in potassium levels		Apply fertilizers recommended in results of a soil analysis – recommended quantities should be fully applied
3	Tip burn	Tip burn is characterised by necrosis of leaf margins. This problem is caused by calcium deficiency, rapid growth due to excess nitrogen, high temperature and water stress.	 	Follow fertilizer recommendations which are provided by results of a soil analysis. Supplemental fertilizer should be applied at the right time Soil should be worked well during land preparation to allow adequate root growth Provide adequate irrigation and ensure that cabbages are not water stressed.

GUIDE ON BUYING, TRANSPORTATION AND STORAGE OF PESTICIDES

1 READ LABEL THAT COMES WITH PESTICIDES

2 READ SIGNS ON PESTICIDES LABELS FOR WARNINGS GIVEN ON PESTICIDE



3 READ SIGNS ON PESTICIDE LABELS FOR ADVICE ON PROTECTIVE CLOTHING

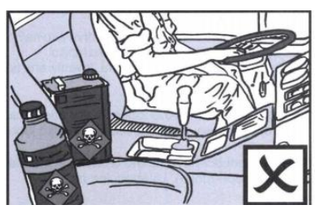
4 READ WARNING SIGNS ON PESTICIDE LABEL ON DANGER OF PESTICIDES TO LIVESTOCK

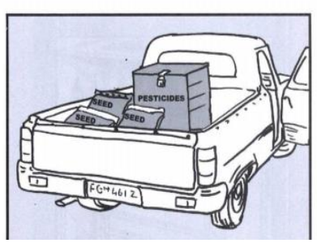
5 PRECAUTIONS WHEN BUYING PESTICIDES

- Be sure of the of the pest or disease you want to control to ensure accurate assistance from extension officers or technical advisors
- Always buy pesticides that are enough for your needs. These should be volumes which can be used completely on the crop
- Do not buy chemicals in broken containers or chemicals which do not have labels
- Read carefully all warnings written on chemicals
- Do not buy chemicals which have been emptied onto other containers

6 PRECAUTIONS WHEN TRANSPORTATING PESTICIDES

- ensure that containers are not damaged to a point of leaking
- To avoid cross contamination do not transport pesticides with livestock feed, clothing, food products and other household goods
- Ensure that pesticide load is tied well and small pesticide bottles have been packed properly
- Pack chemicals in boxes or bags and keep them secure at the back of van or truck
- Never transport pesticides in the same space as passengers , put them at the back of van or truck





7 PFECAUTIONS WHEN STORAGING PESTICIDES

- Always store pesticides in a place that can be locked – storage area should not be accessible for children
- Separate chemicals according to their purpose. Herbicides should be stored separately from fungicides separately and insecticides
- Use old stock of pesticides first, this will reduce likelihood of using expired chemicals
- Make sure that there are no fire outbreaks next to place where chemicals are kept
- Keep records of when pesticides were bought and the quantities used
- Inspect storage regularly to identify leakages and broken containers

GUIDE ON APPLICATION OF PESTICIDES

1 READ LABEL BEFORE MIXING PESTICIDES

- Always read label and ask for help if you have any doubts
- Check whether pesticide is suitable for intended use
- How is pesticide applied?
- What do you have to do in case of accidents, like inhalation of pesticide or ingestion?

2 DO THE FOLLOWING BEFORE MIXING AND SPRAYING PESTICIDES

- Remove food and ensure it is covered
- Remove all kitchen utensils
- Make sure no one enters field when spraying

3 ALWAYS WEAR PROTECTIVE CLOTHING FROM THE TIME YOU START MIXING UNTIL YOU FINISH APPLYING PESTICIDES

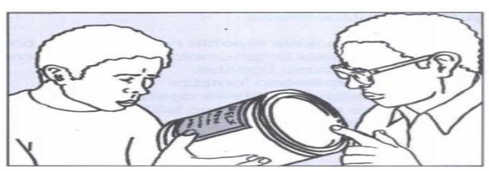
- Wear goggles to protect ayes
- Wear respirator to protect nose and mouth
- Wear a long sleeved overall
- Wear rubber gloves on both hands
- Wear rubber gum boots
- Wear plastic apron if there is a need
- Wear face shield

4 OBSERVE THE FOLLOWING PRECAUTIONS WHEN SPRAYING PESTICIDES:

- Do not spray chemicals when it is windy
- Do not eat, smoke or drink when mixing or spraying chemicals
- Wash your hands as soon as you finish spraying
- Do not allow children and livestock to come close to fields which are sprayed
- Use recommended application rate all the time when spraying pesticide
- Do not spray when there are signs that it will rain

5 MIXING OF PESTICIDES

- Ensure that you have all tools and protective clothing for spraying.
- Have next to you something you can use for wiping pesticide spillages. This includes bucket, broom and cloth which can be disposed immediately after wiping pesticide
- Always read the label before mixing pesticide
- The label will give information on how much pesticide to dilute with water and how much to apply per hectare
- Opening and mixing of pesticides should be done outside. Only mix amount that will be sprayed at that period
- Measure the exact amount of chemical recommended. Do not apply more and do not apply less. Use plastic materials for measuring. Do not use materials made out of wood
- Pour the specified amount into a water (in a bucket) and stir using a stick – do not use your hand
- Do not submerge the end of the water pipe into pesticide mix
- Always use clean water when mixing pesticides



6 ADD MIXED PESTICIDE IN KNAPSACK

- Add roughly half of the required water in knapsack – make sure knapsack is level while it is filled with water
- Add pesticide which has been mixed in a bucket into knapsack
- Add the mixed pesticide slowly
- Triple rinse bucket. Add rinsed water into knapsack
- Add more water into knapsack until it reaches the required level – do not overfill
- Prevent knapsack overflow
- Place the sprayer on the operators back and adjust the lengths of the straps

7 SPRAY

- Place the sprayer on the operator's back and adjust the lengths of the straps
- Operate the pump handle 6 to 8 times to draw liquid into the pressure chamber
- Press on the handle of the trigger valve to spray

PROTECTIVE EQUIPMENT

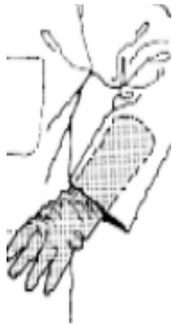
1 SKIN PROTECTION

- The skin is a major route for pesticides to enter the body
- Most exposure of pesticides occurs through hands – this happens mostly during pesticide mixing and loading

Gloves

- By wearing gloves, an applicator can almost eliminate pesticide exposure through the hands
- Wear gloves when:
  - Handling or applying pesticides
  - Rinsing or disposing of pesticide containers
  - Repairing contaminated equipment
  - Washing contaminated application or personal protective equipment

Gloves



- Gloves should be:
  - In good condition
  - Clean
  - Unlined
  - Made of proper pesticide resistant for the pesticide
  - Long enough to cover the wrist and lower forearm
  - Replaced regularly , as some gloves will break down over time
- The top of gloves should be folded to form a cuff

Body covering

- Once on the skin, pesticides can quickly be absorbed into the body
- Skin should be covered to reduce risk poisoning through contact exposure
- Protective clothing should include:
  - Long sleeved shirt
  - Long-legged trousers or overalls
  - Socks
  - Protective footwear

Overall

Feet and head cover

2 EYE AND FACE PROTECTION

- The eyes can absorb and be harmed by pesticides
- To protect the eyes, wear clean goggles with a rubber and plastic or rubber headband
- Wash your clothes with soap and water
- Goggles should fit so that they form a seal around the eyes and have no air vents
- Eyeglasses do not provide complete protection – always wear goggles that fit completely over eye glasses
- Do not wear contact lenses when handling pesticides because they can absorb the pesticide and keep it in contact with the eyes
- A face shield can protect the entire face from pesticide spills or splashes when mixing or loading pesticides
- Goggles should be worn under the face shield to protect the eyes from mist and volatile pesticides

Goggles

Face shield

3 RESPIRATORY PROTECTION

- A respirator that covers the mouth and nose should be worn at all times to prevent pesticide exposure through inhalation
- Pesticide spray droplets, particles and vapours will be kept from entering the lungs when a properly respirator is worn
- Respirator protection is important because pesticides can enter the bloodstream rapidly and fully through the lungs
- If enough is inhaled, pesticides can damage the nose, throat, or lungs, or cause damage to other organs of the body
- Respirators should fit properly, be clean and have cartridges that can remove pesticides from the air that passes through them
- The cartridge or canister should be approved for pesticide use

- Wear unlined boots when mixing chemicals or walking through treated area
- Boots should be made out of pesticide resistant material like rubber or plastic
- A hat made up of non-absorbent material like plastic or rubber should be won

Do not wear hat made out material that absorbs pesticides

Boots

Respirator

WHAT TO DO AFTER SPRAYING AND HOW TO DISPOSE CONTAINERS

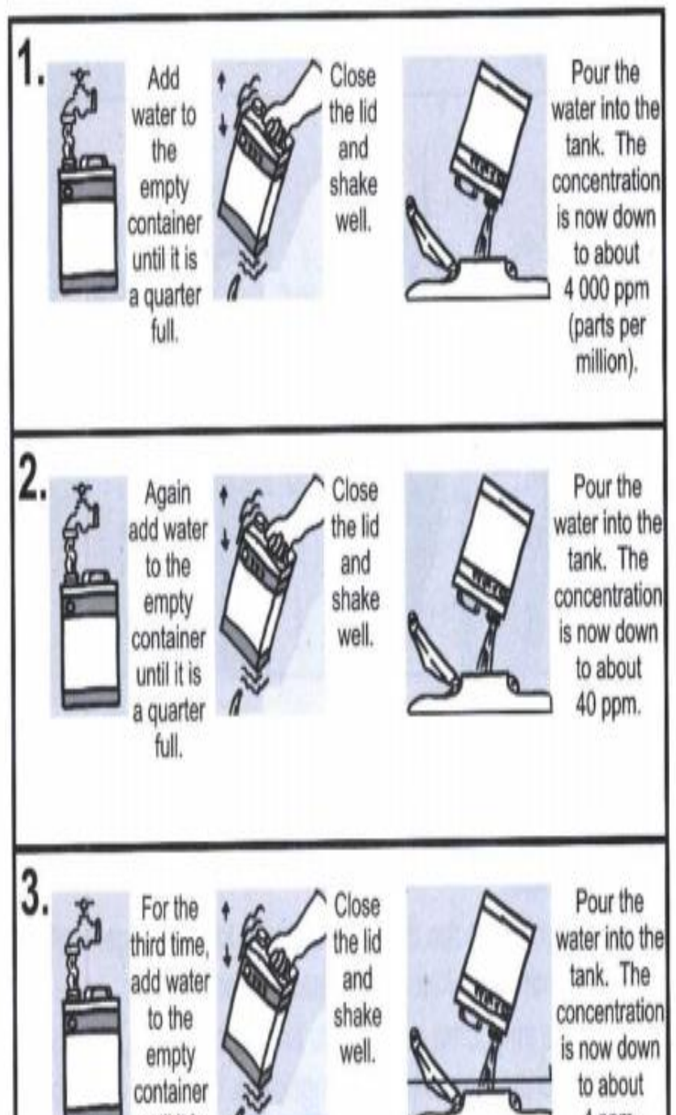
1 OBSERVE THE FOLLOWING PRECAUTIONS WHEN YOU FINISH SPRAYING PESTICIDES

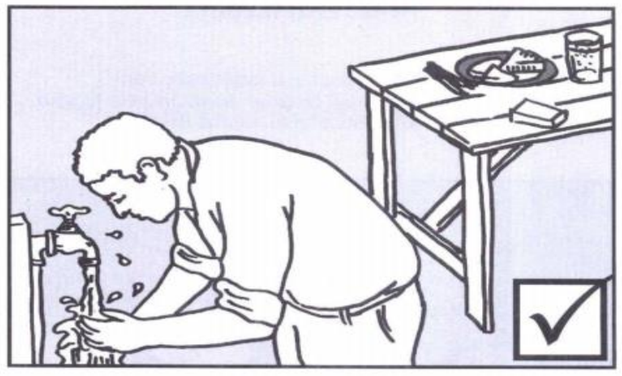
- Wash your hands thoroughly with soap and water – this should be done before touching food, drinks, smoking and before going to the toilet
- Wash your clothes with soap and water
- Wash protective clothes like rain suit alone – do not mix them with clothes
- Gum boots and gloves should be washed on the inside and outside
- Dispose water used for washing protective clothing at a place which is not accessed by people and livestock
- Allow protective clothes to dry before checking them for any damages. Damaged or torn protective clothing should be sown and placed in a safe place in preparation for next spray

2 DISPOSE ALL EMPTY PESTICIDE CONTAINERS

- Do not use chemical containers for other purposes e.g. for keeping potable water
- If containers are made out of paper, burn them – make sure containers are as empty as possible before burning
- Plastic containers and drums should be rinsed three time to ensure that all chemical residues have been removed
- After cleaning, make empty containers unusable by cutting, puncturing or crushing them.
- Burry all destroyed containers in a pit. This should be done away from streams, rivers and other water sources

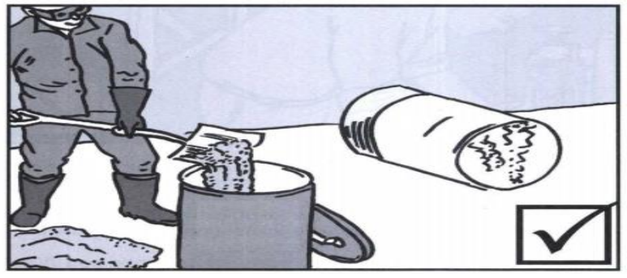
3 FOLLOW THESE STEPS WHEN WASHING CONTAINERS





4 DISPOSE ALL EXPIRED AND OLD PESTICIDES

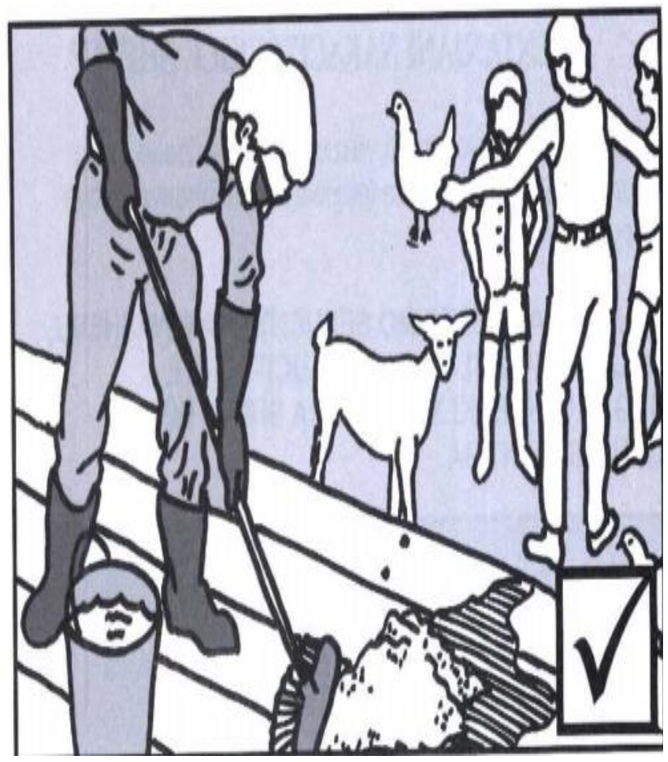
- Before removing old pesticides make sure that you are dressed with protective clothing
- If containers have no labels, consult your extension officer or technical advisor
- Do not throw old pesticides in garbage bins or dust bins
- All leaking containers should be put in a sealed plastic bag before they are disposed



GUIDE ON WHAT TO DO IN CASE OF SPILLAGES AND ACCIDENTAL EXPOSURE TO PESTICIDES

1 OBSERVE THE FOLLOWING PRECAUTIONS IN CASE OF AN ACCIDENTAL SPILL OF PESTICIDE

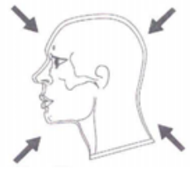
- Stop further spillage of pesticide. If spillage was caused by improperly positioned containers, ensure that you place them in their right position to stop further spillage
- Contain spillage from flowing into more surface area by covering with soil
- Clean up the spill as soon as possible. If pesticide is a powder, use a broom and throw it away afterwards. If pesticide is a liquid, use a cloth and throw it away. Everything that is contaminated with pesticide should be put in a plastic container, sealed and thrown away following guidelines for disposing pesticides



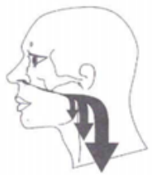
2 THE FOLLOWING ARE SYMPTOMS AFTER EXPOSURE TO PESTICIDES

- Headache
- Nausea
- Salivation
- Dizziness
- Vomiting
- Fatigue
- Impaired vision

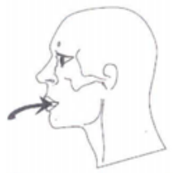
The pictures below show routes through which a person can be exposed to pesticides



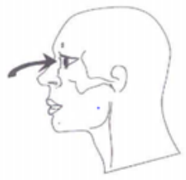
Taken in through skin during contact



When inhaled – through breathing in airborne particles of pesticide



Ingested through the mouth – through eating contaminated food or accidental ingestion



Through eyes – when rubbing eyes with contaminated gloves or through splash and spray drift

3 BASIC FIRST AID OFFERED TO THE SICK IN CASE OF SERIOUS PESTICIDE EXPOSURE

- Read first aid instructions on pesticide label. Follow instructions written on label
- Move patient away from the place where exposure occurred. Do not forget to wear your protective clothing
- If exposure occurred through skin, remove patient's contaminated clothing and footwear at once. Wash patient with soap and cold water. Do not rub patient too much as this might result in scalding. Rush patient to the nearest clinic or hospital / call for medical help
- If exposure occurred through eyes, hold eyelids open and flush them with running cold water for 15 minutes or more. Cover eyes with a clean cloth and transport patient to the nearest clinic or hospital / call for medical help
- If pesticide exposure occurred through ingestion, do not make patient to vomit except if it has been stated so in chemical's information sheet. Rush patient to the nearest clinic or hospital right away / call for medical help
- To induce vomiting, give patient water and put him/her in a sitting or standing position. Have him/her gently tickle the back of the throat with a finger or blunt object. Collect some of the vomit for medical examination
- If exposure occurred through inhalation, move patient to fresh air. Loosen any tight clothing. Tilt the head back with chin forward to promote breathing. Call for medical help / rush patient to the nearest hospital or hospital

HOW TO AVOID EXPOSURE TO PESTICIDES

1 AVOIDING INHALATION

- Wear a proper fitted respirator when mixing and handling pesticides
- Wear proper fitted respirator when working in an enclosed space where pesticides are applied or have been spilled
- Staying away from areas where pesticides have just been applied
- Following precautionary statements on the pesticide label

Inhalation

Respirator

2 AVOIDING CONTACT WITH SKIN

- Keep personal protective equipment clean and in good order
- Remove gloves after pesticide application and prior to clean up
- Wash your hands and face right after handling pesticide or pesticide containers. Do this before eating, drinking, using the toilet or smoking
- Keep contaminated gloves or clothing away from the face or eyes
- Immediately wash ay area where a pesticide has been spilled on the body. carefully remove any contaminated clothing
- Follow re-entry times before going into treated area
- Store personal protective equipment, clean clothing, or personal items separate from where pesticides are stored or handled
- Wear protective clothing when : mixing pesticides, applying pesticides, handling pesticides, and cleaning up spilled pesticides
- To protect the eyes, wear clean goggles with a rubber and plastic or rubber headband

Absorption through skin

3 AVOIDING CONTACT WITH EYES

- Care should be taken with eye protection – this should be done when handling pesticides
- Wearing of goggles and face shield can reduce exposure to pesticides – do not wear eye glasses when handling pesticides
- Washing hands after handling pesticides can reduce the risk of exposure from rubbing eyes
- Measure and pour pesticides below eye level
- Never wear contact lenses when handling pesticides

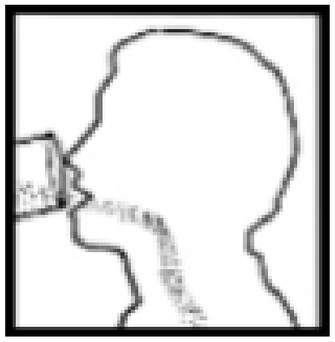
Goggles

Face shield

4 AVOIDING INGESTION OR ORAL EXPOSURE

- If pesticides are ingested, they can burn mouth, throat and stomach
- Store pesticides in original containers. Never use food, coffee, or soft drink containers
- Clean clogged nozzles correctly. Never put a nozzle to the lips or blow into it to clear a clog
- Wash your hands and face after mixing, applying and handling of pesticide containers. Do this before eating, smoking and drinking
- Store pesticides away from food, drink, or tobacco products

Ingestion

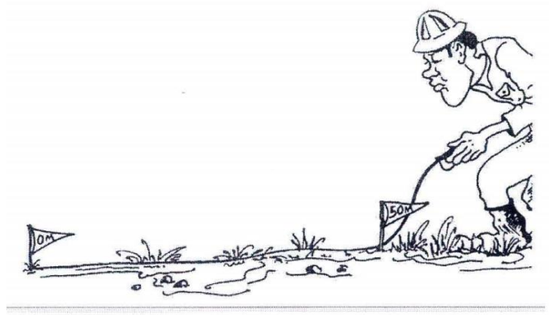


GUIDE FOR CALIBRATING A KNAPSACK SPRAYER

MATERIALS

- 5 Litre bucket
- Watch or stop watch
- Tape measure
- Measuring cylinder
- 2 pegs
- Knapsack sprayer
- Choose right nozzle for intended operation
- Exercise book or piece of writing paper
- Pen or pencil

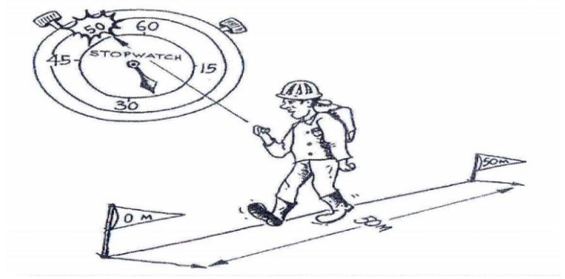
1 MARK OUT A DISTANCE OF 50M ON LEVEL GROUND AND PEG IT



a

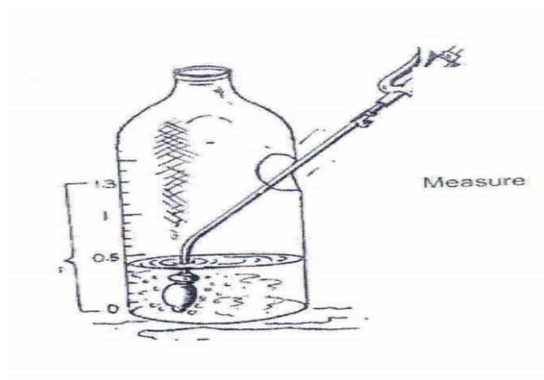
2 FILL KNAPSACK SPRAYER WITH WATER

3 MEASURE THE TIME TAKEN TO WALK THE 50M IN SECONDS WHILE SPRAYING WATER WITH KNAPSACK. MEASURE 3 TIMES AND TAKE AVERAGE



b

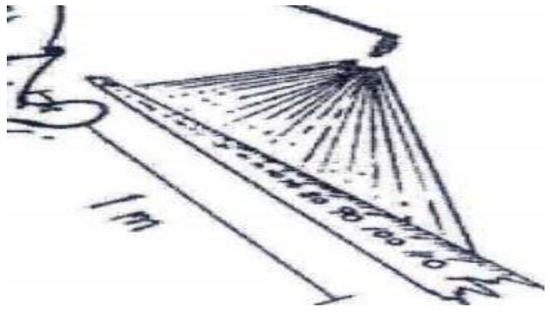
4 SPRAY WATER INTO CONTAINER FOR THE SAME NUMBER OF SECONDS SPENT WALKING AND MEASURE ITS VOLUME IN LITRES



c

5 TAKE SPRAYER TO A CLEAN LEVEL GROUND AND SPRAY

6 MEASURE SWATH / SPRAY WIDTH IN METRES



d

7 WORK OUT SPRAY VOLUME OF WATER NEEDED FOR 1 HECTARE

$$\frac{\boxed{c}}{\boxed{a}} \text{ X } 10\,000\ m2 \text{ X } \boxed{d} = \boxed{e} \text{ L/Ha}$$

8 WORK OUT VOLUME OF CHEMICAL TO BE ADDED TO A 15L OR 20L KNAPSACK WHERE THE CHEMICAL RECOMMENED IS f L/ Ha

$$\frac{\boxed{f} \text{ Recommended X 20 L knapsack X 1 000}}{\boxed{e}} = \boxed{g} \text{ ml}$$

9 CALCULATE THE NUMBER OF 20 L KNAPSACKS NEEDED FOR 1 HECTARE

$$\frac{\boxed{e}}{20\ L} = \boxed{h} \text{ Knapsacks}$$

1 Measure the area of the field to be sprayed

i M2

1 Calculate the number of knapsacks needed for the field to be Sprayed

$$\frac{\boxed{i}}{10\,000\ m2} \text{ X } \boxed{h} = \boxed{j} \text{ Knapsacks}$$

- MAKE SURE THE NUMBER OF KNAPSACKS USED FOR THE FIELD TO BE SPRAYED ARE EQUAL TO j
- CONTACT EXTENSION OFFICER IF YOU NEED HELP

CONTACT SUPPLIER FOR MAINTENANCE OF SPRAYER

PLANTING CALENDAR													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tomatoes	Lowveld	N	N	S	B	B	S	S	B	B	S	N	N
	Middleveld	S	B	B	S	N	N	S	B	B	B	N	N
	Highveld	B	S	S	N	N	N	N	S	B	B	S	S
Pepper	Lowveld	S	S	S	B	S	S	S	B	S	S	S	S
	Middleveld	S	B	B	S	N	N	N	B	B	S	S	S
	Highveld	S	S	N	N	N	N	N	B	B	S	S	S
Butternut	Lowveld	N	N	S	B	B	S	S	N	N	N	N	N
	Middleveld	S	B	B	S	S	N	S	B	B	B	N	N
	Highveld	B	S	N	N	N	N	N	B	B	B	N	N
Carrot	Lowveld	N	N	S	S	B	B	S	S	N	N	N	N
	Middleveld	S	S	B	B	S	S	S	B	B	B	S	S
	Highveld	S	B	B	S	S	S	S	B	B	B	S	S
Beetroot	Lowveld	N	N	B	B	S	S	S	B	S	S	N	N
	Middleveld	S	S	B	B	B	S	S	B	S	S	S	S
	Highveld	S	B	B	B	S	S	S	B	B	S	S	S
Cabbage	Lowveld	N	N	S	S	B	B	S	S	N	N	N	N
	Middleveld	S	S	B	B	B	S	S	B	B	B	S	S
	Highveld	S	B	B	B	S	S	S	B	B	B	S	S
Onion	Lowveld	N	S	B	B	S	S	N	B	S	S	N	N
	Middleveld	S	B	B	S	N	N	N	B	S	S	N	N
	Highveld	S	B	B	S	N	N	S	B	S	N	N	N
Potato	Lowveld	N	N	S	B	B	B	S	N	N	N	N	N
	Middleveld	S	B	B	S	S	S	B	B	S	S	S	S
	Highveld	S	B	N	N	N	N	B	B	B	S	S	S

B - Best planting time
S - Suitable planting time
N - Time not suitable for planting

APPENDIX 2 – LIMING GUIDE

LIMING GUIDE												
Recommended rate	1 ton/ha		2 tons/ha		3 tons/ha		4 tons/ha		5 tons/ha		6 tons/ha	
Area for 1 x 50kg bag	500m²		250m²		165m²		125m²		100m²		83m²	
	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length
	1	500	1	250	1	165	1	125	1	100	1	83
	2	250	2	125	2	83	2	63	2	50	2	42
	3	165	3	83	3	55	3	42	3	38	3	38
	4	125	4	63	4	41	4	31	4	25	4	21
	5	100	5	50	5	33	5	25	5	20	5	17
	6	83	6	43	6	28	6	21	6	17	6	14
	7	71	7	36	7	24	7	18	7	14	7	12
	8	63	8	31	8	21	8	16	8	13	8	10
	9	56	9	28	9	18	9	14	9	11	9	9
	10	50	10	25	10	17	10	13	10	10		
	11	45	11	23	11	15	11	11				
	12	42	12	21	12	14						
	13	38	13	19	13	13						
	14	36	14	18								
	15	33	15	17								
	16	31	16	16								
	17	29										
	18	28										
	19	26										
	20	25										
	21	24										
	22	23										

The European Union is made up of 27 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.

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