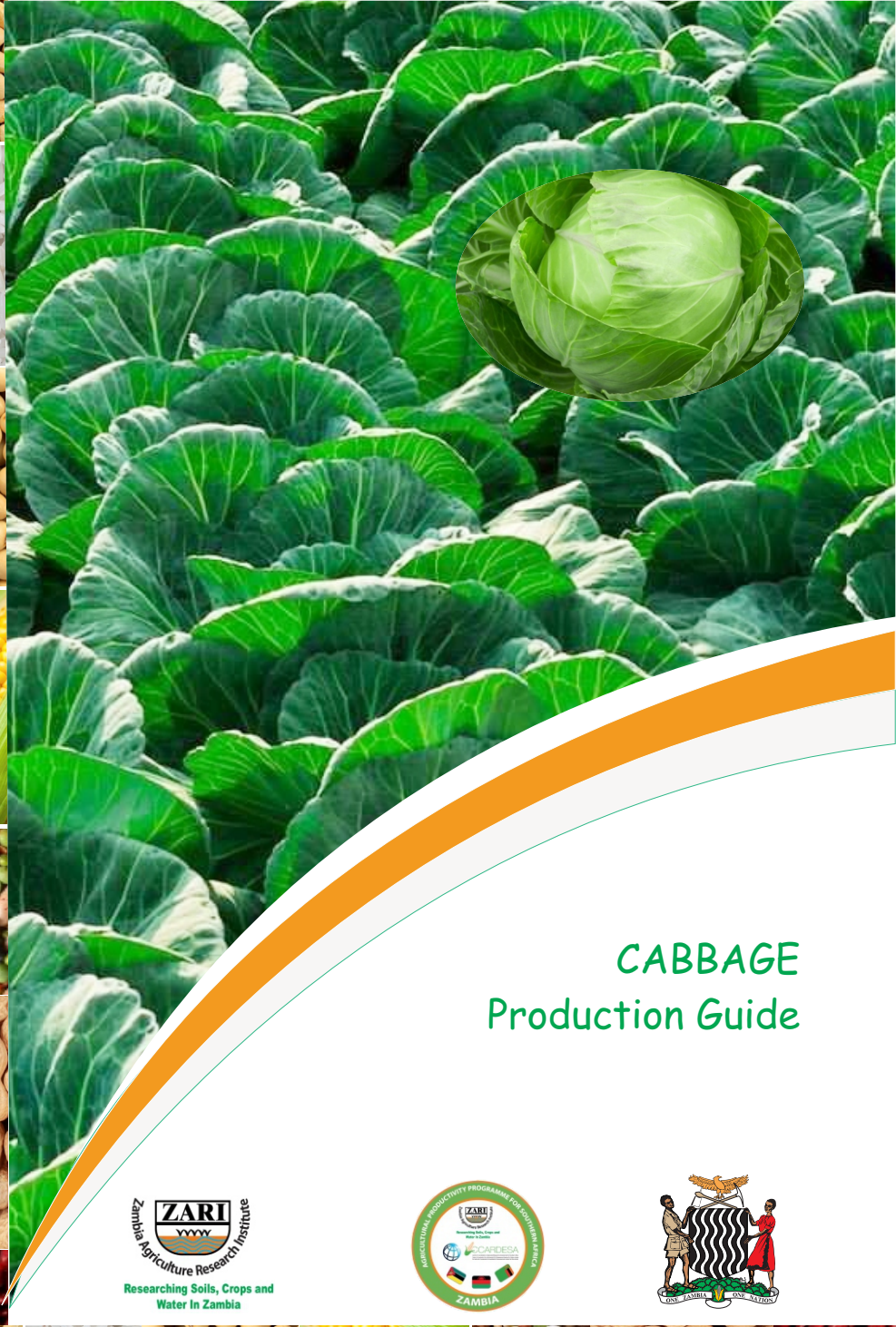

CABBAGE
Production Guide

Zambia Agriculture Research Institute
Researching Soils, Crops and Water In Zambia

ONE ZAMBIA ONE NATION

Agricultural Productivity Program for Southern Africa (APPSA)

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Foreword

Zambia has the potential to produce sufficient food for its citizens and for export.
In order to ensure that good agricultural practices are employed by farmers, crop specific production information should be made available to them.

Due to technological advances and the changing environmental and socio-economic conditions it became necessary to revise the first edition of the Cabbage Production Guide, which was published in 2002. This revised edition is meant to provide farmers and other stakeholders crop specific information in order to promote good agricultural practices and enhance productivity and production.

The information contained in this booklet has been generated over a number of years of research and is appropriate for all categories of farmers. The information is meant for extension officers, agricultural training institutions and other development partners.

It is my sincere hope that this information will go a long way in stimulating Cabbage production in Zambia.

The Zambia Agriculture Research Institute (ZARI) is committed to alleviating poverty and enhancing food security by contributing to increased and sustainable food production.

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1.0 Introduction

Cabbage (*Brassica oleracea var. capitata)* is a cool season crop that withstands extreme cold and frost. This crop, like all other Brassicas is mainly cultivated for their leaves, and play an important role in the Zambian diet. It can be boiled or consumed raw as a salad.
Cabbage can be grown in all the three agro-ecological regions of the country by all categories of farmers.

2. Climatic and Soil Requirements

2.1 Climate

The growth, development and yield of Cabbage tend to be influenced by changes in weather. In the hot weather for instance, the head size and flavour are negatively affected. Cool weather is the most ideal for growing cabbage. In Zambia, this is done under irrigation during the cool dry season.

2.2 Soil types

Brassicas prefer fertile, well drained soils, with a high organic matter content and good moisture-retention ability. Although cabbage can grow on all soil types, growth is affected by highly acidic soils below pH 5.5. Low soil pH can also flavour development of clubroot, although the disease is not a problem in Zambia.

3. Recommended Varieties

Open pollinated cultivars such as Main Crop are recommended to be grown during the cool dry season. Hybrids such as Riana F1 are ideal during summer and rainy season because they are tolerant of excessive heat, moisture, as well as pests and diseases.

The recommended varieties available in Zambia and their characteristics are given in the table below. These are not ZARI developed varieties although some of them have been evaluated for adaptability to Zambian conditions.

Variety	Days to Maturity	Disease Resistance
Riana FI	105	Resistant
Marcanta FI	105	Resistant
Drum Head	110	Susceptible
Golden Acre	107	Susceptible
Rotan FI	103	Tolerant
Gloria FI	103	Tolerant
K.K. Cross FI	103	Tolerant
Bruinswick Ladu	105	Susceptible
Copenhagen Market	100	Susceptible
Ray FI	104	Tolerant
Main Crop	107	Susceptible

The above list of recommended varieties may not be exhaustive as new varieties are likely to continue to be introduced on the market.

4. Recommended Management Practices

Year round planting is possible depending on choice of the cultivar. Best growing conditions are during cooler months of April to July. Hybrid cultivars such as Riana F1 and Marcanta F1 can also be grown during the warm dry season from August to October and in the rainy season from November to March.

4. 1 Land Preparation

The soil must be finely tilled using a garden fork or hoe.

4.2 Planting

Sow seeds in a nursery in a finely prepared seed bed at a depth of 0.5-1.0 cm in furrows spaced 30 cm apart using a seed rate of 600 g/ha. Thin out later to 3-5 cm between the seedlings and ensure protection from pests and diseases.

When seedlings are 4-6 weeks old, transplant into the field using

inter-row spacing of 45-60 cm and within row spacing of 30-50 cm. Furrows, micro-basins, or flat beds can be used for planting in the dry season. In the rainy season, the crop should be planted either on ridges or raised beds.

4.3 Fertiliser Use

Apply 800 kg/ha of D compound together with 25-30 kg/ha Borate as basal dressing. Where compost or manure is available, it is advisable to incorporate 1.5 to 3 kg/m^2 into the soil before transplanting. Provide two split applications of ammonium nitrate as top dressing at 100 kg/ha 3 weeks from transplanting and another 100 kg/ha a month from the first application. If Urea is used apply 75 kg/ha at first application and another 75 kg/ha for second application.

4.4 Irrigation

Cabbage needs ample moisture throughout the growing period especially during head formation.
The amount to irrigate is 20 minute pumping with a treadle pump on a 100 m^2 plot or 1 bucket of 15 litre per $m^{2.}$

The irrigation schedule under different soil, climatic conditions and growth and development stages is given in the table below.

Growth	Initial Stage			Development			Harvesting Stage		
Climate	Hot	Mod	Cool	Hot	Mod	Cool	Hot	Mod	Cool
Light Soil	2	3	3	2	2	3	2	2	3
Medium	3	4	4	2	2	3	2	2	3
Heavy Soil	4	5	6	2	2	3	2	2	3

4.5 Weed control

For cabbage, the levels of weed control may be minimal where seedlings are transplanted in the field as opposed to direct sowing. The crop should be kept weed free at all times to realise best harvests. Weeds can also be controlled manually either by hand hoeing or hand pulling. It is advisable to use recommended herbicides to control weeds.

5. Crop Protection

There are few insect pests and diseases of economic importance of cabbage in Zambia. It is however susceptible to a number of diseases that reduce the yield and quality of the produce. There are measures that can be taken to minimize the damage.

5.1 Major diseases and control measures

The major diseases are Blackrot, Soft rot and Downy mildew.

5.1.1 Blackrot *(Xanthomonas campestris)*

This is a serious bacterial disease that limits cabbage production in the rainy season in Zambia with losses of up to 70 % recorded. The most commonly observed symptom is produced on the foliage of older plants. Typically, large necrotic V-shaped lesions occur on the leaf margins. These are dirty-grey to light brown in colour. A progressive yellowing of the leaf occurs as the pathogen proceeds into the vascular system of the leaf stalk and main stem. When such a stem (or stalk) is cut, blackened infected tissue will be seen in the vascular system.

Control Measures

Control of this disease is by use of resistant cultivars, use of clean disease free seed, and removal of infected plants. Application of appropriate fungicides and spore-kill as a disfectant is recommended.

5.1.2 Soft rot *(Erwinia carotovora)*

This disease often affects the crop in the rainy season. Affected parts become water soaked and develop a soft rot with a distinctive foul smell.

Control Measures

Control of this disease is by improving drainage in the field and removal of infected plants.

5.1.3 Downy Mildew *(Peronospora parasitica)*

This is a fungal disease in which yield losses of up to 20 % have been recorded. The affected leaves have small yellow spots. Leaf lesions are light green, then turn yellow with mould on both sides of the leaf in the widening yellow area but not in the dead, shrunken, grey or tan central portion. Secondary fungi often cover dead parts with a black sooty mould.

Control Measures

Avoid crowding of plants. Spraying cabbage seedlings with an appropriate fungicide is recommended. Furthermore, treatment of heading cabbage every 6 to 7 days beginning 1 to 3 weeks before harvest with an appropriate fungicide is also recommended.

5.2 Major Insect Pests and Control Measures

Common pests of cabbage in Zambia include Diamondback moth *(Plutella xylostella*), Aphids, Serpentine Leafminer *(Liriomyza spp*), Bugrada bugs *(Bugrada hilaris)* and Oriental cabbage worm *(Hellula undalis)*.

5.2.1 Diamond back moth

The damage is caused by the larvae which hatch from eggs laid by an adult moth on leaves and petioles. The newly hatched larvae which are green to yellow-green feed on leaves so that only the thin outer epidermis is left, giving a cellophane (mesh) like appearance to the feeding site.

Diamond back moth

The succulent growing point may also be attacked, in which case, no leaves or only deformed ones will develop. After seven to ten days, the larva forms a silken cocoon on the leaves where it pupates. Adults emerge three to six days after pupation.

Control Measures

Control of this pest can be achieved through the following measures:

i) Use of cultural practices such as destroying plants of all Brassicas after harvest.

ii) Use of biological insecticide such as Bacillus thuringiensis

(Bt). This has the advantage of not destroying natural enemies such as wasps.

iii) The pest can also be controlled by use of selective insecticides such as Alfamethrin (Fastac) or Lambdacyhalothrin (Karate).

Iv) Spray with botanical extract such as those from neem leaves or kernels.

Early detection of pest infestation through regular scouting is an essential component of managing the pest.

5.2.2 Aphids

These are small-bodied sucking insects. Three different species that attack cabbage are *Brevicoryne bassica*, *Lepaphis erysimi* and *Myzus persicae.*

Infected leaves may become yellow, pale, sooty, waxy or curled. Aphids induce stunting on young plants and may lower the quality of the cabbage head.

Aphids

Control Measures

Control of this pest can be achieved through the following measures:

I) Isolate new crop from infested crop

ii) Use of selective aphicide Pirimicarp (Pirimor) complement beneficial insects such as parasitic wasps, lacewings and ladybird beetles

iii) Spray with an insecticide such as Fastac or Karate.

5.2.3 Serpentine Leafminer *(Liriomyza spp.)*

The larvae make characteristic silver tunnels under the leaf cuticle. Damage only occurs when larvae occur in large numbers. Natural enemies usually keep the pest under control.

Control Measures

If the infestation is severe, spray with an insecticide such as Fentrithion.

5.2.4 Harlequin bugs or Bugrada bugs *(Bugrada hilaris)*

These are sucking insects often seen in mating pairs. They can sometimes cause serious damage in young growing cabbage and rape plants.

Control Measures

Spray with Lambdacyhalothrin (Karate) or Alfamethrin (Fastac). The spray should be directed at the base of the plant where the adults usually hide. Regular irrigation suppresses the pest.

5.2.5 Oriental Cabbage Worm *(Hellula undalis)*

This is an occasional pest that can cause enormous damage at the beginning of the rainy season.

Control Measures

If control is required the approach is as with Diamondback moth.

6.0 Harvesting

Time of harvesting of cabbage is variety dependent. The right time is when the heads are fully developed and firm.

Harvesting is done by cutting at the lowest point possible above ground level. Late or early harvesting will affect the flavor of the cabbage.

Compact headed cabbage cultivars like Riana F1 and Marcanta F1 have a longer shelf life than open pollinated cultivars such as Drum Head or Golden Acre.

7. Post Harvest Handling and Processing

Outer cabbage leaves should not be excessively removed at harvest to avoid quick wilting of the head. Removal should be restricted to the old diseased or yellowed leaves. After harvest cabbage should be stored under cool, dry conditions.

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