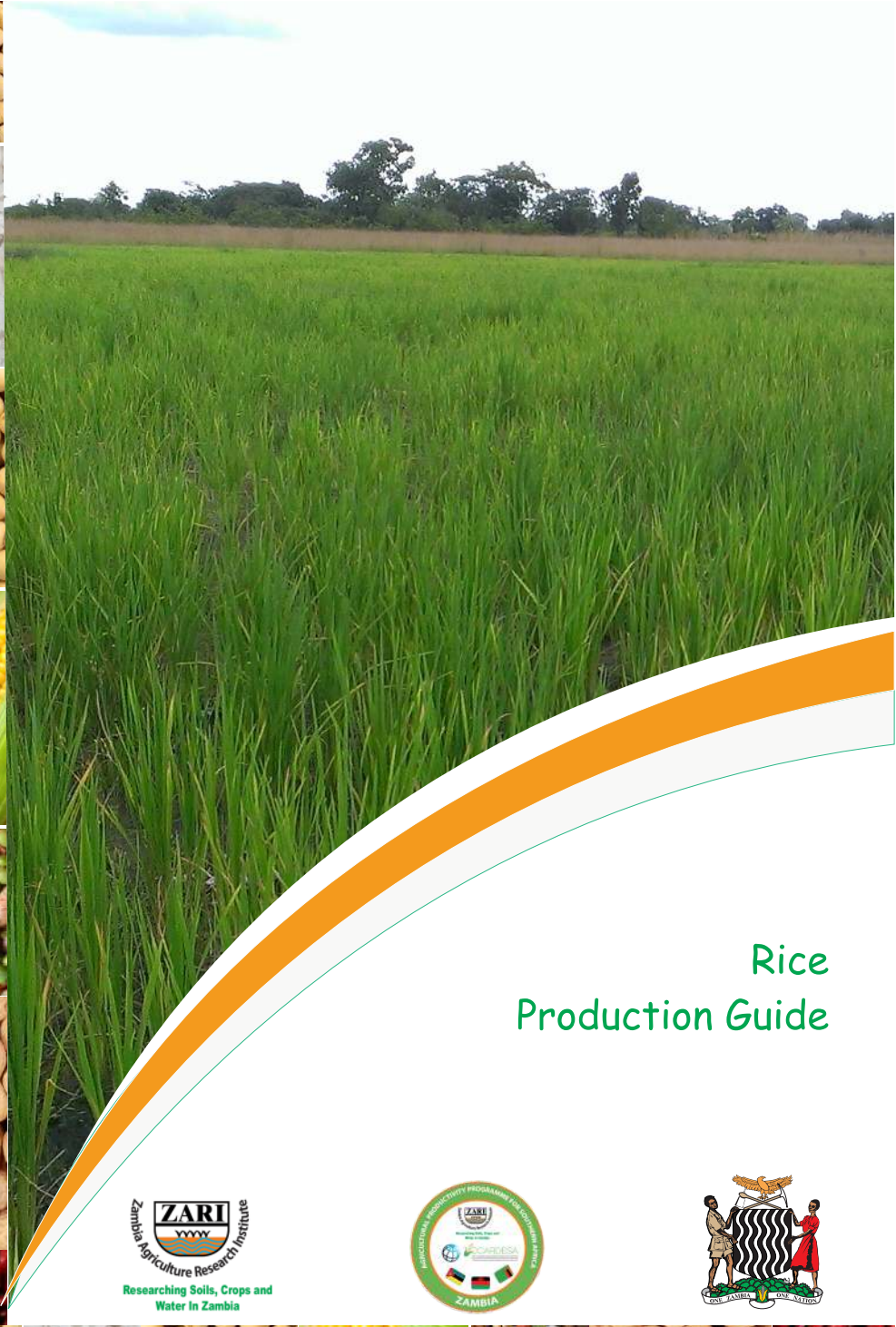

Rice Production Guide

Zambia Agriculture Research Institute

Researching Soils, Crops and Water In Zambia

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 Rice 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 rice 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

Rice is the most important cereal food crop in the world used by more than 50% of the world's population. Cultivated rice has two distinct species: Oryza sativa L (Asian Rice) and Oryza glabberima STEUD (African Rice). It is a semi-aquatic annual grass plant, which grows well in standing water for most of its growing time.

Because of its long history of cultivation and selection under diverse environments, rice has acquired a broad range of adaptability from deeply flooded land to dry hilly slopes. High yields are obtained in moderate to fertile soils and sufficient moisture conditions during its growing period. Factors governing wide adaptability of rice are mainly its insensitivity to day-length and tolerance to temperature change.

In Zambia rice is mainly grown by small-scale farmers in the floodplains of Zambezi and Chambeshi rivers of Western and Northern provinces, dambos of Luapula and Eastern province and as well along the river valleys. With introduction of rainfed upland (NERICAs) rice can now be grown under upland rainfed conditions where other crops such as maize, millet and sweet potatoes are grown.

2.0 Climatic and Soil Requirement

2.1 Climate

Rice is best suited for cultivation in tropical and sub-tropical humid climates. However, it can be grown in a variety of climates, except in extreme cold temperature conditions. The climatic factors that affect rice production are temperature, day length and humidity, which are known to significantly influence yield. Day temperatures of 250C to 320C and night temperature of 150C to 200C are preferable. Temperatures beyond 35oC not only reduces pollen viability but also grain filling.

Clear sunny weather during ripening and moist-humid weather during vegetative phase is desirable for the rice crop.
A relative humidity of 60-80 % is optimal for rice production.

In general rice requires a lot of moisture and can grow well in areas receiving rainfall above 800 mm.

High wind velocity or storm is not desirable, as it causes lodging or shattering depending upon the crop growth stage.

2.2 Soil Types

Loamy to clay-loamy friable soils are best suited for rice cultivation. The optimal soil pH ranges from 6.0 - 7.0. On acidic soils, especially in rainfed rice, phosphorus deficiency often occurs along with aluminium toxicity. Zinc deficiency may appear in certain soils. Rice tolerates moderate levels of salinity.

In irrigated rice, heavier soils with high water holding capacity and low water infiltration, are preferred.

3.0 Recommended Varieties

In Zambia most farmers grow traditional varieties, some of which are derived from improved varieties introduced from other countries sometime back. Most of these varieties are suited for cultivation under rainfed lowland flood plain ecologies.

New rice varieties adapted for cultivation in upland rainfed ecologies are now available.

Currently available rice varieties and their characteristics are given in the Table below:

Variety	Day to Maturity	Major Characteitics	Ecology	Average Potential Grain yield (ton/ha)
Nerica 1	100	Maturity:100 days Grain shape: elongated Aromatic	Upland rainfed	3.5
Nerica 4	100	Maturity:100 days Grain shape: elongated Non -Aromatic	Upland rainfed	4.5
Mulonga	130	Maturity:130 days Grain shape: bold Non-Aromatic	Lowland rainfed	2.5
Kilombero	140	Maturity:140 days Grain shape: elongated Non-Aromatic	Lowland rainfed	3.5
Angola Crystal	140	Maturity:140 days Grain shape: Bold Non-Aromatic	Lowland rainfed	5.0
ITA 230	140	Maturity:140 days Grain shape: bold Non-Aromatic	Lowland rainfed	5.0
Longe 1	110-115	None aromatic, good lodging and disease resistance	Upland rainfed	4.0
Longe 2	110-115	None aromatic, good lodging and disease resistance	Upland rainfed	4.0
Longe 3	125-135	None aromatic , good lodging and disease resistance and low shattering	Upland rainfed	5.0
Supa-Mg	140	Aromatic	Lowland rainfed	3.0

4.0 Recommended Management Practices

4.1 Site Selection

Choose areas or sites that are fertile, have enough water during most parts of growing cycle of rice. The rice field may be flat undulating land for better distribution of water, or in the floodplains, and in dambos, or along the river valleys.

4.2 Land Preparation

Land for planting rice should be ploughed at least twice to create a fine tilth to facilitate easy germination and enhance crop growth. Best time for tillage is when the soil is moist. Early plowing is recommended where the soil is sandy-loam as it is relatively easy to

work at any time of the year even when moisture content of the soil has reached saturation level. Land should be ploughed either by a tractor, ox-drawn plough or hoe and later harrowed to break large clods of soil to a fine tilth so as to allow for even germination and water distribution.

4.3 Planting

Time of planting

The time of planting rice varies with varieties. Late maturing varieties should be planted early, from mid November to third week of December. Early to medium maturing varieties could be planted up to mid January.

There are three methods of planting rice. These are broadcasting, drilling/dribbling and transplanting.

Broadcasting

This method involves spreading of rice seed on a piece of cultivated land. Thereafter, the seed is incorporated into the soil by either raking, hoeing or harrowing.

Drilling

Drilling involves making furrows 3 cm deep in rows of 25 cm apart, thereafter dropping seed continuously along the furrow. To ensure evenly distribution, place about 50 seeds per meter and cover with soil. Line planting gives better crop management especially when weeding.

Transplanting

A nursery of rice is established for transplanting to permanent fields.

The recommended seed rate is 28 kg/ha (7 kg/lima) for transplanted rice; 60 kg/ha (15 kg/lima) for drilled planting and 80 kg/ha (20 kg/lima) for broadcasting.

4.4 Fertiliser Use

In order to enhance plant growth and development rice requires application of both basal and top dressing fertilizer. D compound as basal fertilizer is applied at 200-300 kg/ ha (50-75 kg/lima) and

incorporated in the soil before planting. Urea or Ammonia Nitrate as top dressing fertilizer is applied at 100-200 kg/ha (25-50 kg/lima) six weeks after emergence or 3 weeks after transplanting. Nitrogenous fertilizer such as urea is not recommended in rainfed broadcasted rice, but its use efficiency is noticed in rice planted in lines as fertilizer is easily incorporated in the soil. Modern varieties respond favorably to the effect of nitrogen resulting in increased grain yield.

4.5 Weed Control.

Weeding is done at least two times during the growth cycle of rice, at 21 days and 42 days after plant emergence. The follow up weeding would be dependent on the levels of weed infestation. Use of transplanting as a planting method reduces the number of weedings.

Chemical control such as the use of glyphosate (round up) as post emergency herbicide applied prior to planting of rice, is recommended.

4.6 Crop Rotation Practices

In Zambia rotation is applicable in the upland and dambo fields. However, in flood plains the major constraint in rotating paddy rice is the excess moisture availability during the season and off-season, which will not favour other crops. In dambos, crop rotation can be practiced by planting vegetables such as beans, rape, cabbage, tomatoes and onions after rice. Agroforestry species, such as Sesbania, that can supply additional soil nitrogen and organic matter that improves the texture of the soil may be used.

5.0 Crop Protection

Rice is susceptible to a number of insect pests and 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 their control measures

5.1.1 Blast *(Pyricularia oryzae)*

The disease is found in many rice growing areas with losses of up to 70 % recorded. The incidence of this disease is higher in upland rice. The disease affects all parts of the plant but mainly the panicles. On panicles, all parts of the rachis or rachilla may be infected. Most often, the basal node of the panicle is infected, resulting in 'neck rotting'. Bluish-grey fungal growth and sporulation occurs on infected regions. Early infection results in white heads or partially filled heads while late infection after grain filling results in 'broken necks'.

Rice blast on panicles

Control Measures

These include cultural and sanitary methods such as destruction of diseased crop residue, and ensuring that plants remain flooded and use of clean and disease free seed.

The disease may also be controlled by the application of appropriate fungicides that are effective in treatment of the disease.

5.1.2 Brown Spot *(Helminthosporium oryzae)*

This pathogen attacks rice plants at all growth stages. The disease affects all parts of the plant including leaves, panicles and stems. It is characterized by large brown spots which later coalesce to form lesions on leaves. The occurrence of the disease is influenced by high humidity, temperature above 200C, potassium imbalance and low soil fertility or when rice is grown in saline soils.

Brown spot

5.1.3 Sheath Blight *(Rhizoctonia solani).*

Yield losses of up to 100 % have been recorded. Sheath blight appears as lesions on the leaf sheath from the seedling through to the grain stage. Grey-green water-soaked spots 1 cm long and circular to oval, develop then enlarge to be bleached with an irregular purple-brown border. Hyphae may spread over the plant until it turns grey and dies. Sclerotia, which is white, then turn brown, develop on the leaf sheaths. Infected plants may lodge, poorly fill with grain resulting in poor yield.

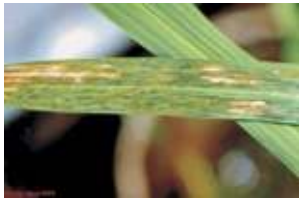
Control Measures

The following cultural and sanitary practices can be used to control disease incidence:

a) Long term crop rotations reduces incidence of the disease
b) Practice field sanitation by removing weeds.
c) Application of well-balanced NPK fertilizer.

5.1.4 Bacterial blight *(Xanthomonas oryzae)*

Yield losses of up to 60 % have been recorded. The first symptom of the disease is a water-soaked lesion on the edges of the leaf blades near the leaf tip. The lesions expand and turn yellowish and eventually greyish-white.



Bacterial blight

Control measures

Control measures include use of disease-free seed, controlling weeds and volunteer plants, removal of and destruction of diseased plants as well as restricting nitrogen fertilizer application to about 80 – 100 kg/ha.

Seed treatment with an appropriate chemical reduces incidence of bacteria blight.

5.2 Major Insect Pests and Control Measures

The most prevalent pests of rice in the country are birds and rodents. Birds attack the rice shortly after emergence in direct-seeded rice and from flowering time onwards. Birds cause more damage to shattering varieties than to non- shattering types. Rodents, particularly rats, cause serious damage to the rice crop at all stages. They eat seeds (in direct-seeded rice) and seedlings and they destroy rice that has been stacked, stored and threshed.

Rodents

Other insect pests are stem borers, Gall Midge, White Grubs and Leafhoppers and Plant Hoppers. The different types of Stem borers include the White borer *(Maliarpha separatella rag*), Striped borer *(Chilo zacconius Blesz)* and Pink borer (*sesamia calaministis* Hampsoro).

In Zambia almost all the insect pests mentioned above have not reached epidemic levels yet, hence no control measure is necessary.

5.2.1 Birds

A number of bird species are a pest of rice. Birds feed on seeds planted in the ground; tear the leaves of growing plants (for food or nesting materials); attack ripening grain and fruit on the plant; and cause physical damage, e.g. trampling of young rice plants by waders. More indirect losses may arise, e.g. spreading of seeds of weeds, including parasitic mistletoes.

Control Measures

Destruction of bird nests may help to contain numbers at crucial times if nests are located within a relatively small area.
Birds are mobile and tend to flock together, and often show a group response to an alarm; therefore bird scaring is recommended.

Methods range from simple scarecrow devices to more modern behaviour-based approaches including suspended shapes of birds of prey, or the broadcast relay of specific alarm calls. Timing is crucial for effective control.

6.0 Harvesting

Harvesting of rice should commence when at least 80% or 1/5 of the panicle has turned golden yellow. Late harvesting of rice may lead to shattering and high breakages at milling. Rice can be harvested by cutting the plants with a sickle.

7.0 Post-harvest handling and processing

Harvested rice should be stock piled and threshed immediately after harvest. Thresh on tents to avoid rice being mixed with stones, which reduces its value.
Paddy rice is best milled when at 14% moisture content.

7.1 Drying and Storage

Rice should be dried to 14% moisture content before bagging and storing in dry and pest free granary.

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