



Rain-fed Wheat Production Guide



Researching Soils, Crops and
Water in Zambia



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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 Rainfed Wheat 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 Rainfed wheat 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.

A handwritten signature in blue ink, consisting of stylized initials and a surname, written over a light blue horizontal line.

M. Mwale
Director,
Zambia Agriculture Research Institute,
Ministry of Agriculture,

2018

Acknowledgements

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1.0 Introduction

Wheat (*Triticum aestivum*) is an annual crop belonging to the grass family gramineacea. Rain-fed wheat can be grown both as a cash and food crop. It is a minor crop in Zambia mostly grown by small scale farmers. Apart from the bakery industry, the harvested grain can also be used at household level as a source of food in form of nshima; or boiled whole grain.

A major advantage of growing rainfed wheat is the low cost of production and therefore can be grown by small scale resource-poor farmers. Recent wheat production figures have indicated production levels of 274,000 to 300,000 metric tonnes against a total annual wheat requirement of about 254,000 metric tonnes. Currently, the contribution to national wheat production of rainfed wheat is insignificant.

Though at low scale, rainfed wheat has been grown in the high rainfall agro-ecological zone III since the 1970s.

2.0 Climatic and Soil Requirements

2.1 Climate

Most rainfed wheat is grown in Agro-Ecological zone III, which is characterized by high annual rainfall of above 1000 mm with cool to warm temperatures of between 18-28°C during the growing season, and a long growing season of 150 - 180 days.

2.2 Soil Types

Ideal soils for wheat production should be clay-loamy and well drained with a pH above 4.8.

3.0 Recommended Varieties

Varieties currently recommended for rainfed wheat production are Coucal and Kwale. These varieties are suitable for small scale producers and have good resistance to prevailing diseases of wheat. They are also tolerant to low soil pH.

The major agronomic attributes of these varieties and their yield levels are given in the table below.

Variety	Days to Maturity	Yield (t/ha)	Plant Height (cm)	Resistance to <i>H. sativum</i>	Resistance to <i>X. cam-pestis</i>
Kwale	115– 130	2.5	72	MR	MR
Coucal	100–120	3.0	118	MR	MR

MR=Moderately resistant

Please note that there are also other varieties released by seed companies.

4.0 Recommended Management Practices

4.1 Land Preparation

There are mainly two land preparation methods, which are the conventional, where land is ploughed and disced to a fine tilth, and minimum tillage where land is not ploughed and residues are retained.

For conventional land preparation, initial ploughing should be done at the beginning of the rainy season followed by preparation of the fine seedbed at planting. Wheat requires a fine tilth to ensure uniform distribution of the seed within the row in order to encourage uniform emergence.

4.2 Planting

Planting Time

Rain-fed wheat can be planted between 25th December and 15th January.

Planting Method

Make rows 25 cm (or 20 cm) apart using a hand-drawn rake, an ox-drawn rake or a rope and stick. Sow seed to a depth of 4 - 5 cm either

by hand drill or use of a push-planter. On lighter soils planting depth can even go up to 7 cm without affecting emergence.. For hand-drilling aim for 60 to 80 seeds per meter length. Once planted, seed must be properly covered with soil.

A seed rate of 25kg/lima or 100kg /ha is recommended. Lower seed rates will lead to thin stands while higher seed rates may lead to lodging. Seed treatment is recommended for the control of soil borne diseases and pests. Fungicides such as, Captasan, vitavax, thiram and others may be used. In termite prone areas, seed may also be treated with a termiticide such as Gaucho, and others.

Sow in rows 25 cm apart to facilitate hand weeding and 4-5 cm deep. If able to control weeds by spraying, row spacing can be reduced to approximately 20 cm apart.

4.3 Weed Control

Weeds can be controlled by use of hand hoe from two weeks up to four weeks after planting or as needed. Chemical weed control is also possible, using recommended herbicides such as Prowl (pendimethaline) as pre-emergence and MCPA, 2,4-D as post emergence..

4.4 Fertiliser Use

For basal dressing 300 Kg/ha of WVC or “D” compound fertilizer can be applied and for top dressing 50kg per Lima or 200kg/ha of Urea. Where Urea is not available, Ammonium nitrate can be applied. Basal fertiliser should be broadcasted before planting and worked into the soil or drilled with the seed. Urea should be applied at 4 to 6 weeks after emergence.

Micronutrients such as boron are essential for prevention of ear sterility. In soils where boron is deficient, fertilisers which contain boron like WVC should be used.

Soil testing is recommended for more specific fertilizer requirement.

Liming

Lime should be applied in soils with pH lower than 4.8 (CaCl_2). Lime should be broadcast and incorporated in the soil before planting. Depending on the soil moisture condition, the recommended waiting period of 10 days between liming and basal fertiliser application may be reduced.

5.0 Crop Protection

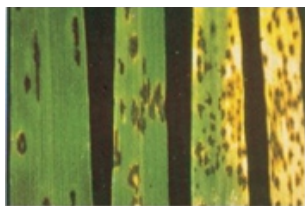
Rain-fed wheat is susceptible to a number of insect pests and diseases that reduce the yield and quality of the produce. There are measures that can be taken to minimize the damage.

5.1 Major Diseases and Control Measures

Major diseases of rain-fed wheat are Spot Blotch (*Helminthosporium sativum*) and Bacterial Blight (*Xanthomonas campestris*). Minor diseases include Head Scab (*Fusarium* spp.), Stem rust and Leaf rust.

5.1.1 Spot Blotch (*Helminthosporium sativum*)

This disease is the major limiting factor to rain-fed wheat production in Zambia. Infection may occur at any stage of plant development, but symptoms are usually more pronounced after heading. Infected seedlings develop dark brown necrotic lesions on roots, crowns and lower leaf sheaths. Leaf blades and leaf sheath infection (the spot blotch stage) develop as distinct oval to elongated light to dark brown blotches. Under conditions favourable for disease development, the spikelets may be affected, causing shriveling of the grain and staining the embryo end black, a condition called “Black Point”.



H. sativum on leaves



Black point on grain

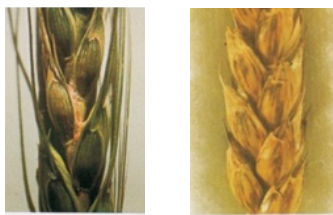
Control Measure

Use of resistant varieties is recommended as a control measure against the disease.

The other disease control option is seed treatment where the seed is suspected to be infected.

5.1.2 Black Chaff (*Xanthomonas campestris*)

The leaves have elongated light brown lesions that later merge to form large necrotic lesions. The plants become susceptible at tillering stage. Less susceptible varieties head normally but later heads that are infected show typical symptoms of black chaff on the heads.



Black chaff on glumes

Control Measures

Control measures include use of resistant varieties, seed treatment and practicing crop rotation.

5.1.3 Head Scab (*Fusarium spp.*)

The infected grains shrivel, turn white and dry up. As the crop matures, light pink to orange-coloured conidial masses accumulate at the base of the spikelets. The edges of the kernels on infected spikelets become shrivelled and non-viable. Besides the direct crop loss effect caused by *Fusarium spp.*, there is also the potential danger of mycotoxin production.

Control Measures

Use of resistant varieties offer the best strategy for the management of the disease.

5.1.4 Root Rot (*Rhizoctonia solani*)

This is a soil-borne pathogen which infects the crop at seedling

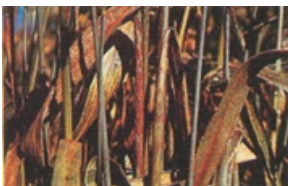
stage, especially during dry spells. It causes seedling blight damage leading to death of seedlings.

Control Measure

Cultural practices include deep cultivation, providing plants with adequate nutrition and proper field sanitation by keeping fields weed free.

5.1.5 Stem Rust (*Puccinia graminis*)

It produces dark reddish-brown elongated pustules on stems, upper and lower surface of leaves and sometimes also on the heads.



Stem Rust

5.1.6 Leaf Rust (*Puccinia recondita*)

The disease is characterised by small oval shaped orange-red coloured pustules which occur on the upper surface of leaves and on leaf sheaths.



Leaf rust

Control Measures

Leaf rust is best controlled by the use of resistant varieties. Appropriate fungicides may also be used if an epidemic occurs.

5.2 Major Insect Pests and Control Measures

Major insect pests affecting rainfed wheat production include Termites and Stem borers. Minor insect pests include White grubs and Army worms.



white grub

Control Measures

Crop rotation and field sanitation are some of the methods that can be employed to control termites.

In areas prone to severe termite infestation use of chemical control is recommended. This includes the use of chemicals such as Gaucho, which can be applied both as seed treatment and sprays to control termites at seedling stage and in later crop growth stages respectively.

In cases of minor insect pest, chemical control may become necessary when an epidemic occurs. Chemical that may be used include, Sevin, Endosulfan or Pyrethroids.

Bird scaring at grain filling stage may be necessary at some sites. Farmers should look out for this problem as yields can be drastically reduced.

6.0 Harvesting

When crop turns yellow to brown cut entire straw using sickles. To test readiness for harvest, rub a sample of the grain in the palm of the hand, if ripe, the grain will come easily out of its kernel or husk. To avoid grain loss harvest before the grain is over ripe.

7.0 Post Harvest Handling and Processing

7.1 Threshing and Storage

Threshing may be done manually using sticks or allowing animals to trample on the harvested crop or using mechanical threshers.

Threshed grain should be .store in a cool dry place. If stored for longer periods treatment with a grain protectant such as Actellic Super is necessary. In case of farm saved seed, this should be

treated with Actellic Super or Shumba.

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