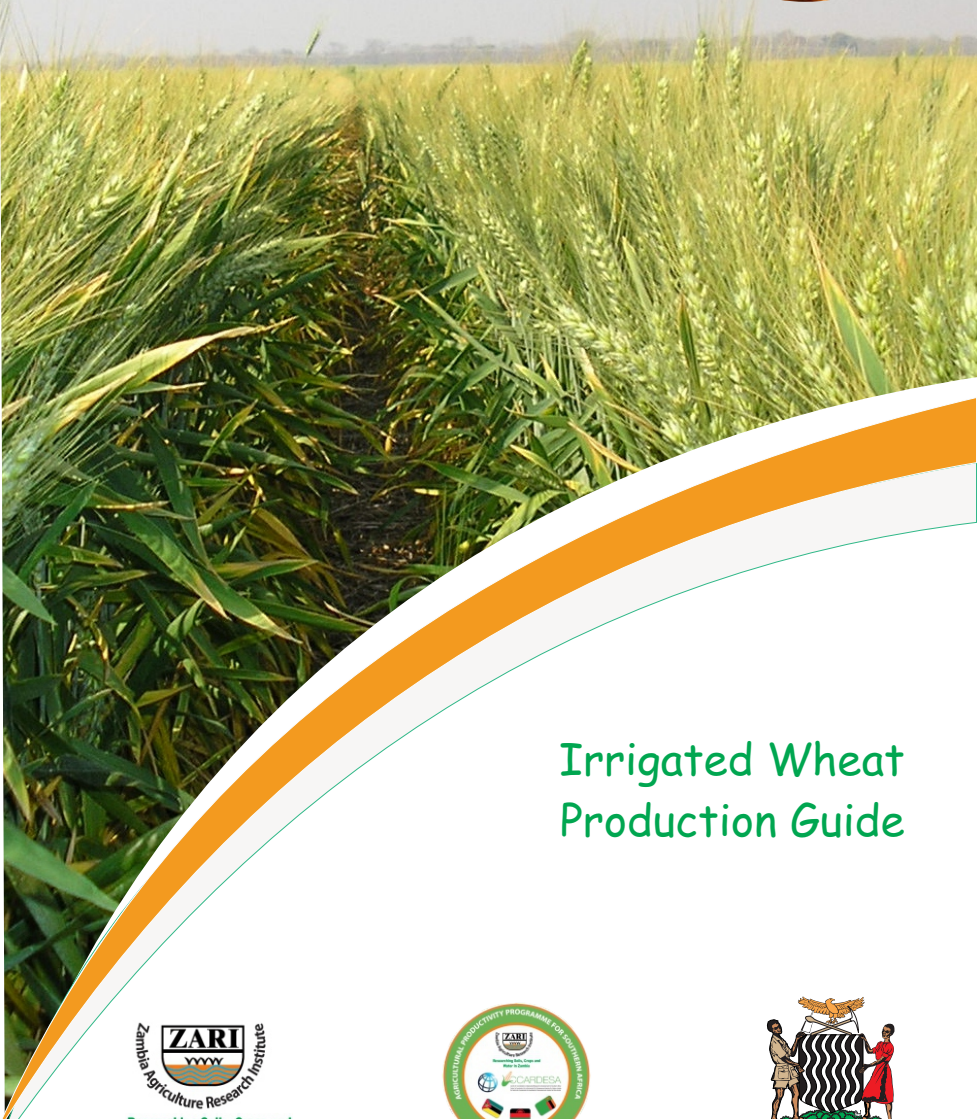




Irrigated Wheat Production Guide



Table of Contents

Foreword	ii
Acknowledgements	iii
1.Introduction	1
2. Climatic and Soil Requirements	1
3. Recommended Varieties	2
4. Recommended Management Practices	2
5.Crop Protection	5
6. Harvesting	8
7. Post- Harvest Technology	8

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 farmer's 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 Irrigated 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 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.



Director
Zambia Agriculture Research Institute,
Ministry of Agriculture,

2018

Acknowledgments

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1.0 Introduction

Irrigated Wheat (*Triticum aestivum*) is an annual crop, which is grown both as a cash and food crop. The bulk of wheat in Zambia is planted under irrigated conditions. Recent wheat production figures range from 274,000 to 300,000 metric tons against a total annual wheat requirement of about 254,000 metric tons.

Most irrigated wheat production is carried out in the agro-ecological zones I and II, which include Central, Lusaka and Southern Provinces. Production of wheat in these regions is mostly by commercial farmers that have access to irrigation facilities. It is possible for small scale farmers to also grow the crop using furrow irrigation.

2. Climatic and Soil Requirements

2.1 Climate

Most Irrigated wheat is planted in the medium rainfall agro-ecological zone II. This region is characterised by temperatures ranging from 20°C to 30°C during the rainy season, average annual rainfall of 800-1000mm, and a wet season of 120-150 days. Irrigated wheat is, however, planted from April to May, after the rainy season. During the initial part of the growing season (May, June) temperatures can be as low as 15°C, which is important for tillering of the crop. The temperature rises to about 37°C at the close of the season (September, October)

2.2 Soil Types

Clay loam soils are the best for wheat production. Wheat can, however, be planted also on sandy loam soils. In this case, it is important to take note that irrigation interval needs to be adjusted to take care of the rapid water drainage from the soil. A pH of 6.5 provides optimal conditions for the growth and development of the wheat crop.

3. Recommended Varieties

Currently there are 3 recommended irrigated wheat varieties. These and their major agronomic attributes are given in the table below.

Variety	Days to Maturity	Height	Leaf Rust Resistance	Stem Rust Resistance	Powdery Mildew	Yield (t/ha)
Loerie II	120-130	94	MR	R	MR	7.0-8.0
Nseba	120-130	70	MR	R	MR	7.0-8.00
Mampolyo	120-130	90	MS	R	MR	7-8

M=Moderate, R=Resistant, S=Susceptible

Please note that there are other varieties available in Zambia that have been developed by seed companies.

4. 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.

4.2 Planting

Planting Date

Planting is normally done between mid-April to June. In the low lying areas of Regions I and II the month of April is preferred while the optimum planting time on the plateau is during the first three weeks of May.

Planting Method

Sow in rows 25cm apart to facilitate hand weeding and 4-5 cm deep. If able to control weeds by spraying, row spacing can be reduced to approximately 20cm apart. Seed must be covered and in close proximity with the soil. On lighter soils planting depth can even go up to 7cm without affecting emergence. Shallower planting is not recommended.

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.

4.3 Weed Control

Grass weeds are generally not a problem in irrigated wheat. 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 500 Kg/ha of WVC compound fertilizer can be applied and for top dressing 300kg/ha Urea can be applied when grown in rotation with soybeans which is not fertilised. Otherwise, on well fertilized rotated land 300 – 400 Kg/ha of basal (WVC) and 300Kg/ha of top dressing (Urea) are recommended. Micronutrients such as boron are essential for prevention of ear sterility. In soils where boron is deficient fertiliser mixture which is boronated like WVC should be used.

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 first irrigation.

Specific fertilizer and nutrient recommendations should be based on soil analysis for particular farms. Depending on the soil test results the table below can be used as a guide to determine the appropriate recommendations.

Late top dressing tends to increase protein content rather than yield on heavier textured soils. On heavier soils all the nitrogen may be broadcasted before planting.

Liming

For soils with pH less than 5.0 application of lime is recommended and rates vary according to soil types, as shown in the table below. Soil and water tests recommended.

Fertility Status	Kg/ha			
	N	P ₂ O ₅	K ₂ O	S
Low	120-150	80-120	40-60	20 minimum
Medium	100-120	50-70	20-30	20 minimum
High	70-90	20-40	0	20 minimum

4.5 Crop Rotation Practices

Irrigated wheat fits well into a rotation with soybeans, potatoes, groundnuts or tobacco. Maize, cotton, sunflower are best grown after wheat as timeliness of land preparation can prove difficult.

Soil Type	Critical pH(CaCl ₂)	Maintenance Lime(kg/ha)
Sand	4.6	500-1000
Sandy Loams	4.8	1000-1500
Sandy Clays	5.0	1500-2000

4.6 Water Requirements

The total water requirement for wheat over the growing season is between 400-500mm (4,000-5,000m³/ha) with high regime for light soil and low regime for heavy soils. Wet the soil prior to planting. A light irrigation after seeding will aid emergence and prevent capping. Where soils are clay-loam irrigation should start 3-4 weeks after planting at intervals of 14-18 days. On sandy-loam soils, start irrigation 2-3 weeks after planting at intervals of 7-10 days. Increase the amount of water per application from flowering onwards. Irrigation should continue until the crop is in the hard dough stage.

5. Crop Protection

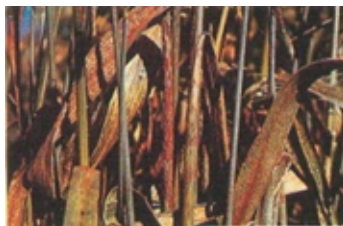
Irrigated wheat is susceptible to a number of insect pests and diseases that reduce the yield and quality of the produce. There are measures that can be taken to minimize the damage.

5.1 Major Diseases and Control Measures

Diseases posing potential threat to irrigated wheat include stem rust (*Puccinia graminis*), leaf rust (*Puccinia recondita*) and powdery mildew (*Erysiphe graminis*). Other wheat diseases that are becoming prominent include *alternaria spp*, Bacterial leaf streak (*Xanthomonas spp*) and Head Blight (*Fusarium graminearum*).

5.1.1 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

5.1.2 Leaf Rust (*Puccinia recondita*)

The disease is characterized 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.

5.1.3 Powdery mildew (*Erysiphe graminis*)

The disease manifests itself as irregular patches of white fluffy growth on the upper surface of leaves and in severe cases it affects heads as well. Early symptoms appear as colonies of fluffy superficial mycelium, which are white to light grey in colour on the surfaces of the leaf blades. Under favourable conditions, the leaf sheaths and spikes may be affected. The under sides of affected leaves have yellowish necrotic spots at the infection sites.

Control Measures

The best form of disease control is the use of resistant varieties. However, if severe infections occur early in the season application of appropriate chemical control may become necessary.

5.1.4 Alternaria Leaf Blight (*Alternaria spp.*)

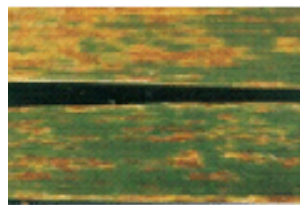
This saprophytic fungus develops on plants approaching maturity and show small, oval, chlorotic lesions scattered on lower leaves.

Control Measures

Alternaria can be controlled by planting resistant cultivars and by applying low cost fungicides such as Benomyl, Zoom and Saaf before symptoms appear.

5.1.5 Bacterial Leaf Streak (*Xanthomonas spp.*)

Under field conditions, symptoms may be found at all growth stages, but are most frequently observed after flowering. On leaves, bacterial streak symptoms appear as small, light-brown, water soaked streaks that tend to be confined by the veins. Often the lesions will begin at the edges or midrib of leaves.



Vent homonas spp on leaves

Under severe conditions, the streaks may coalesce giving the heads a dark appearance, and the grain may be brown and shriveled. The pathogens may also attack the stem and peduncle, causing black streaks or uniform black lesions.

Control Measures.

This disease can be controlled by seed treatment, use of resistant varieties and cultural methods such as crop rotation, tillage and weed control.

5.1.6 Head Blight (*Fusarium graminearum*)

Head blight becomes noticeable before the head matures. Infected spikelets first appear as water-soaked and become bleached straw coloured. During warm weather conditions the infected spikelets show a salmon pink colour and later infected kernels will shrivel and become chalky white, to pink and light-brown, depending upon the time of infection and environmental conditions during disease development.



Head blight

Control Measures

Control Head blight by use of resistant varieties, use of cultural practices such as crop rotation and application of fungicides such as Benlate and Zoom.

5.2 Major Pests and Control Measures

Insect pests are usually not a serious problem on irrigated wheat. Termites can, however, be a problem when relatively dry conditions prevail during the growing season. Birds may also cause significant damage to the grain, especially on small fields.

Control Measures

In case of bird damage, bird scaring is the most effective control measure.

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.

6. Harvesting

Harvesting should start when the crop has reached physiological maturity, which is about two weeks after the crop has turned from green to yellow. At small scale use of sickles may be employed. On large commercial farms combine harvesters can be used.

7. 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 stored in a cool dry place. If stored for longer periods treatment with a grain protectant such as Actellic Super is necessary.

For bulk storage use of silos where temperature and humidity is controlled is recommended. Under these conditions the grain can be stored for pro-longed period of time until it is ready to be disposed

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