WHEAT GROWERS GUIDE

Contents

Soils and Climate

Wheat is a temperate crop and is best grown in winter under irrigation with optimum day temperatures of between 15 – 20^{O}C and cooler nights giving the best yields. There are some varieties that may be grown in summer (such as Sahai), but generally there is high disease and weed pressure in summer accompanied by warmer temperatures that result in depressed yields (≤ 3t/ha), therefore, winter is the best time for growing wheat.

The crop is adapted to a wide range of soils. The soils must be well drained with an optimum pH range of 5.5-6.5 on a Calcium Chloride scale. Wheat yields are greater in the highveld (>1200 masl (metres above sea level)) and middleveld (900 – 1250 masl) with yield potential of 8 to 12 t/ha compared to the lowveld (<900 masl) where yields average of 4.5-7 t/ha under good management.

Varietal choice.

New varieties are continuously produced for wheat production because of the threat of disease (especially Leaf Rust and Powdery Mildew). The varieties from Seed Co, ideal for bread making, are short statured, disease resistant and well adapted to winter production. Current varieties include SC Nduna (White seeded), SC, SC Sekuru (Red seeded), SC Smart (Red seeded) and SC Stallion (red seeded), Sky (Red seeded), Select (White seeded), Serena (White seeded). SC Sahai is a summer variety which can be planted in mid-summer, around January.

Land preparation and soil conditioning

The most suitable soil for wheat is one with:

- A good effective depth with a fine tilth to ensure seed-soil contact. Good seed-soil contact ensure good crop emergence and stand which are the basis for good yields
- Favourable physical properties: good internal drainage, an optimal moisture regime,
- Chemical properties: sufficient and balanced quantities of nutrients (NPK and other micro-nutrients/trace nutrients)
- Biological properties: good level of organic matter, and with beneficial micro-organisms

The objective of soil tillage is to maintain the existing structure of soil or to improve the structure of poorly structured soils as well as addressing the three properties as mentioned above (physical, chemical and biological).

Soil conditioning

- Lime can be applied if required to 'sweeten' acidic soils to the pH optimum range. Lime application should be based on soil analysis prescriptions.
- Gypsum improves soil physical structure i.e. removes hard setting clodiness, removes surface crusting and poor workability as well as supplying the soil with complimentary Calcium and Sulphur for good crop standing and growth.

Tillage procedures

There are several options of tillage which fall under two broad categories: conservational and conventional tillage which can be adopted in wheat production. The conventional tillage procedure follows the following steps:

Deep ploughing (ripping or chisel plough), liming and basal fertilizer application, discing and then followed by rolling. A roller can be pulled concurrently behind a disc harrow. Conservational tillage also known as zero/minimum tillage is another cheaper and more sustainable option which farmers can adopt.

Time of Planting.

The optimum time for planting winter wheat is between mid-April and the last week of May and even earlier in the Lowvelds. Sometimes planting time can be extended to mid-June but not normally recommended. Delayed planting results in a loss of about 50kg/ha/day after May. The first two weeks of May tend to give the best yields in the Highveld areas. Adhering to the optimum planting time has some agronomic explanations and rationales:

- Early summer rain escape. Rains which come after the wheat has reached physiological maturity causes sprouting (grain germination in the ear) and result in down grading of the wheat due to a decline in baking qualities
- Disease escape - disease pressure especially for rust diseases, normally rises when temperatures start to warm up around August and an early planted crop would have gotten a good head start without disease pressure.
- Pest escape - likewise pest pressure such as aphids start to rise when temperatures start to rise. An early planted crop will have a good head start ahead of pest pressure.

- Early planting will result in early harvesting around September. One of the key considerations for the adoption of double cropping is early planting and early harvesting for both summer and winter crops. The farmer will come in with his summer crop on time when wheat is planted and harvested early. Generally, wheat takes about 125-140 days to physiological maturity depending on variety, altitude and weather conditions. The higher the altitude, the longer the time from planting to maturity.
- Wheat critical stages such as crop establishment, tillering, flowering and grain filling will concide with the optimum growth conditions when the crop is early planted. For instance, for robust tillering i.e. for the plant to produce secondary stems (4 – 5 weeks after crop emergence) requires very cool conditions that normally occurs in May and June while Flowering (60 - 90 days) and Grain filling (> 90 days) must not coincide with frosty conditions to avoid crop sterility.

Seeding Rates.

The optimum plant population for wheat is 220-250 plants per m^2. Seed rate depends on the seed size, germination percentage, planting conditions and planting method. To achieve optimum population density, a seeding rate of about 110-125 kg/ha when drilling and 125-135 kg/ha when broadcasting with a vicon spreader is recommended. To ensure good crop standability and yield, farmers should adhere to these optimum population densities. Diseases such as Powdery mildew are also minimized with good agronomic practices.

Irrigation requirements and scheduling

Since there is very little or no rainfall during winter in Zimbabwe, irrigation is required to achieve a high yielding wheat crop. The total gross amount of water required is between 450 and 600 mm per ha (i.e. 4.5 - 6 mega litres per ha) depending on method of irrigation (Overhead irrigation with sprinkler or use of Centre Pivots) and must be applied as the crop requires it. The key points are:

- the soil must be brought to field capacity to the full potential rooting depth (about 1,2 m) at planting to emerge the crop;
- a light irrigation must be applied at the 4th or 5th day after sowing, to break the crust to ensure good crop emergence

- a light irrigation must be applied at 14 to 17 days after emergence to stimulate crown root development and tillering, and;
- irrigation thereafter must be applied to match crop water use. On sandy soils with low water holding capacities, irrigate frequently (7 to 9 day cycles with 30-35mm net). On clays and sandy clays, with good water holding capacities, irrigation may be less frequent with larger amounts (10 to 14 day cycles with 40-45 mm net). This is a general irrigation scheduling guide. For an informed irrigation scheduling, the use of a soil auger to evaluate the soil water content ahead and behind the irrigation line is a good aid to irrigation management. Irrigation is terminated when the neck of the ears/spikes/head (peduncle) turn yellow i.e. physiological maturity.
- Crop hardening

  After the crop has emerged, the hardening stage begins. This induces crown root development as well as tillering. The recommended hardening period (irrigation is temporarily terminated during this stage) is 10 and 14 days in light and heavy soils respectively.
- Top dressing fertilizer and herbicide application is done after a light irrigation which follows the hardening period, normally about 21 days after emergence.

Fertilisation.

The fertiliser regime management in wheat, like any other crop must be tailored to the soil fertility status, the yield potential and the grain quality requirements. As a general guide, wheat requires a basal application of 300 to 500 kg/ha of a compound fertiliser (such as 7-14-7) and a top dressing of 350 to 500 kg of Urea or Ammonium Nitrate per ha. Both fertilizer dressings are broadcast by a vicon.

Generally, 160 -190kg/ha of Nitrogen Units (N), 50 - 70 units of Phosphorous (P) and 30 – 50 units of Potassium (K) are adequate for optimum plant growth. Basal fertilizer need incorporation into the soil by discing and should be applied after primary tillage. The top dressing is usually applied in one application between 14 – 21 days after emergence on heavy soils, and in two applications of equal amounts at 14 and 35 days after emergence on sandy soils. Top dressing should be applied after the hardening stage. Top dressing is essential for good leaf and general plant growth and ultimately the yield but also importantly for attaining good protein

levels. The minimum protein level requirement for "Premium" (Good quality) wheat is 11%. It is one of the considerations for grading and pricing of wheat. Attainment of good protein levels is also determined by varietal choice and general management. Application of Nitrogen after flowering can also boost the Grain Protein Content of wheat.

All fertility management practices must be based on proper full soil analysis recommendations by approved laboratories.

Weed control

Farmers are advised to use some wheat specific post-emergence herbicide which should be applied after a light irrigation which follows the hardening period (2 WACE-Weeks After Crop Emergence). We also recommend farmers to apply specific herbicides against volunteer crops. Puma super is normally sprayed when wheat is planted after a maize crop against maize volunteer plants. For soya volunteers, a herbicide called ally is recommended. Banvel and MCPA combination covers a wide spectrum of broad leaf weeds and is recommended.

It is important for farmers to read labels whenever they are applying herbicides.

Pests and diseases.

Aphids and stalk borers can attack wheat with aphids coming in earlier soon after tillering while borers can attack the plant from flowering onwards. Farmers must also be on the look-out for "Fall armyworm" given that wheat is one of the host crops to the pest. These pests can be controlled with appropriate pesticide sprays after scouting.

During the late grain-filling period, Quelea birds may consume much grain and reduce yields significantly if not attended to. A pesticide molecule called 9,10-Anthraquinone 50% WP (Bird Shield) has been developed, which can be used as a seed dressing or as a foliar spray at soft dough stage. Efficacy of this pesticide molecule can be enhanced by applying with a sticker and also a rainfast period of 4 hours or more. This pesticide molecule will act as a bird repellent. This is the best and the most efficient option. The other option is bird-scaring using bells, tins, whistles, discs/reflectors etc. by bird scaring gangs.

Diseases such as Leaf rust, Stem rust, Powdery mildew, Fusarium head blight and Take-all may cause yield reduction. Farmers must seek professional advice on how to control these diseases. The best bet is for farmers to grow resistant varieties and Seed Co wheat varieties such as SC Select are resistant to these diseases. Generally two preventative fungicide sprays are recommended if farmers are located in disease prone areas and gives some form of insurance against climate change that can result in new disease pathotypes.

NB: Farmers are encouraged to scout their wheat crop for diseases, pests and deficiencies and make spraying decisions early when pest/disease reaches economic threshold levels.

Consult Agrochemical companies for more information on chemicals. Always read chemical labels carefully, use safe practices and adequate protective gear during application.

Wheat production: General tips:

1. ***Plan ahead:*** evaluate available water resources in order to calculate wheat area based on proposed gross application. Irrigation equipment and infrastructure must be ready, with checks made on pumping unit, conveyance system, pivot, sprinkler condition and nozzle wear.
2. ***Soil condition and fertilisation:*** Soil sampling is always the starting point in determining the rates and types of soil conditioners and fertilisers to be used.
3. ***Start at Field capacity:*** Crop emergence requires a soil profile that is at field capacity down to the full potential of the rooting depth. This should be achieved by the 3 – 4 leaf stage, at the latest. This is important because wheat roots grow downwards at a rate of 20 – 30 mm/day and any dry layers within the profile will impede root growth and proliferation.
4. ***Establishment irrigation:*** Seed germinates happily in the presence of good soil moisture. Establishment irrigations need to be geared to achieve a uniform and adequate stand, and this depends on planting method and uniformity of irrigation. Drilled seed normally requires one good irrigation to cause germination because of good soil-seed contact. Broadcasted seed or zero tillage fields, require frequent (2 – 3 day intervals) light irrigations (25mm) to effect establishment. A light irrigation is essential (4 – 7 days after

the first irrigation) in soils that are prone to crusting to assist with emergence.

5. ***Ensure crown root development and tillering:*** At 3 - 4 leaf stage (14 – 17 days after the first germination irrigation), crown roots and the ear begin to develop and tillers start growing. Water deficit adversely affect these processes yet they play an important role in yield formation. At this stage, usually the top 100 – 150mm of the soil is dry and crown roots will not grow into dry soil. It is necessary to apply a light irrigation to stimulate crown roots and tillering. It is also an appropriate time to top dress the wheat with Nitrogen fertilizer.
6. ***Initiate an irrigation schedule early and monitor the soil and crop through to maturity:*** Scheduling assist the manager to monitor crop progress and thereby ensure the best treatment possible is given to the crop. Assess soil and crop conditions before and after each irrigation cycle to evaluate whether or not the irrigation is recharging the soil profile to the satisfaction of the plant needs. A soil auger is extremely useful in this regard. An auger test ahead of the line will show how deep the plant is drawing water while an auger test two positions behind the line will show how effective the irrigation application is in replenishing the soil. Well irrigated wheat has a dark green colour, soft large leaves and many tillers, whilst "stressed"wheat has a bluish colour, hard, spikey leaves which may also roll up in some varieties, and a few tillers with small ears.
7. ***Crop maintenance:*** Weed, disease and pest control are important in achieving a good crop.
8. ***Timing of the last irrigation:*** There is no point in irrigating a yellowing crop and grains are fully formed and after hard dough stage. Full maturity is reached when the peduncle (neck, area below the ear/spike) turns yellow. Irrigation applied during later grain-fill or during grain dry down is of no value to the crop and may even reduce the quality of the grain. Water after ripening may cause pre-harvesting sprouting (germination in the ear) leading to down grading of wheat due to reduced grain quality.
9. ***Keeping irrigation records:*** It helps to plan future irrigation practices. Useful records include;
   (a) Water usage with a flow meter
   (b) Energy use, either electricity units or diesel litres
   (c) Dates and amounts of irrigation applied

(d) Evaporation and air temperature

(e) Labour

Centre pivot-irrigation scheduling-a general guide.

Generally center pivot irrigation is the simplest method of irrigating any crop. For efficiency, there are factors to consider when using center pivots. It is proven that a farmer gets more effective water application on a fixed center pivot as compared to a towable pivot. This is largely due to the fact that there is run down time loss due to towing from one center to the other.

It is advisable that when using a fixed center pivot anything between a 10mm and 12 mm spray package is recommended. However if it is a towable center pivot and a farmer intends to do two circles with one pivot a bigger spray package is more ideal for the pivot and this can be from 14 mm to 20 mm spray package depending on specific requirements. A bigger spray package is recommended for towable center pivots to reduce the turnaround time of the center pivot to avoid moisture stress in the other circle.

For easy water application, a farmer is advised to run their pivot in **WET** mode. The wet mode allows the operator to program the pivot to apply the exact amount of mm required at the particular stage of growth of the crop. In instances where the pivot is run in dry mode the operator will be required to calculate the percentage on the timer which corresponds with the amount of water (mm) that need to be applied and in most cases errors on calculation are sometimes common and a farmer will not achieve the intended spray volumes. It is advisable then that farmers should ask their centre pivot service provider to program the machine to work in the wet mode.

Chemigation/fertigation calibrations guide.

Calibration factors that need to be considered when using a centre pivot for chemigation and fertigation include the sizing of the dosing pump and its pumping rate. Always ensure you discuss with your pumps specialist before purchasing a dosing pump for correct dosing pump sizing for your applications as applications vary from case to case. It is also important that your fertigation or chemigation unit is as close as possible to the centre pivot inlet as possible

generally not more than six metres. Below are critical factors to be considered when using a pivot for both chemigation and fertigation.

1. Length of the pivot to the edge of the effective wetted area
2. Length of the pivot to the last tower
3. Last tower travel distance in a given amount of time running at present application. This point has to be verified physically by the farmer with the pivot running in wet mode at the present application rate. Do not rely on literature or your pivot control panel as other factors such as terrain (e.g. slope/gradient) can affect your last tower run speed-so this must to be verified.
4. Targeted product application rate in kgs/litres per hectare
5. Product concentration in kgs/litres per m^3 of active ingredient
6. Percentage of a full circle centre pivot that will be used during the application

Harvesting.

On a large scale, wheat is usually harvested by combine, but it is possible to hand harvest and thresh small areas of wheat. Combine harvesters must be set carefully and operated according to Service Manuals in order to keep harvest losses to a minimum.