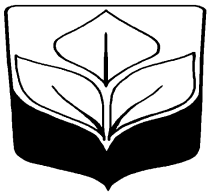

Wheat fertilisation

Wheat has the highest protein content of the cereal grains, containing one-and -a-half times as much protein as maize. Therefore , for each tonne of wheat grain more nitrogen, phosphorus and sulphur must be applied than for a tonne of maize. The nutrients must be readily and rapidly available to ensure the crop grows steadily from start of season. By flag leaf emergence, up to 70% of the nitrogen and phosphorus and 90% of the potassium requirements would have been taken up by the crop. The bulk of the feeding roots of wheat will be in the surface 100-150 mm of the soil, and the fertiliser must be distributed there to ensure it is available to the young roots.

Wheat also requires a higher soil pH, calcium and magnesium content than maize. Unless the land has been well limed to correct pH, the crop will not be able to utilise the fertiliser to full effect. The optimum range of pH ($CaCl_2$) for wheat is 5.0-6.0 on sands and 5.3-6.3 on red clay loams and clays. The pH should be checked regularly so that lime can be applied if necessary when the land is prepared after the preceding crop. The amount of lime required to correct acidity and bring soil to pH 5.5 depends on the clay content of soil.

Lime required to raise the pH of the surface 150 mm of soil to pH 5.5
(kg/ha lime of neutralising value about 100)

Soil Texture	pH of Soil			
	4.4	4.6	4.8	5.0
Sands	1000	600-800	400-600	500
Sandy loams	1000-1500*	1000-1200	600-800	600
Clays	2000-3000*	1500-2500	1000-1500	800

Note: * Repeat lime in following season

To maintain the soil at the correct pH lime should be applied periodically to compensate for nitrogen applied in the rotation; three kilograms of lime is applied for every kilogramme of nitrogen applied in compounds, ammonium nitrate or urea. The amount of lime is not changed with the type of lime selected from registered materials.

Nitrogen is an essential constituent of structural and storage proteins, simple amino compounds, enzymes and chlorophyll. The most obvious symptom of nitrogen deficiency is yellowing of the leaves, starting from the oldest leaves which die back prematurely. Deficient plants are small, slow growing and have weak stems. If nitrogen is deficient in early stages of growth tillering and, most importantly, spikelet formation is inhibited with a consequent reduction of yield.

Phosphorus is a component of all biological membranes and it is essential for all numerous processes by which the sun's energy , absorbed in photosynthesis is converted into compounds, including proteins. Phosphate deficiency retards growth giving stunted plants with a dark green colour. Severe

deficiencies can cause purpling or browning of the leaves. Virgin soils, and thus old reverted lands or those which have been badly managed, are inherently deficient in phosphate in Zimbabwe.

Potassium does not form part of the organic structure of plants. It remains in the sap and is mobile, being involved in the transport of organic salts through the plants. Potassium is necessary for the activation of enzymes. It is also needed for the formation of lignin and strengthening of cell walls; K-deficient plants are more susceptible to lodging and to fungal diseases.

Sulphur is a constituent of methionine and essential protein formation, vitamins and enzymes. For wheat it is important for improving baking quality. Sulphur deficiency is rarely seen in commercial agriculture in Zimbabwe because the compound fertilisers are formulated with enough sulphur to maintain healthy crops. Approximately 25 kgs/ha per year of this element is extracted by the wheat crop. To ensure maximum economic yield without depleting reserves, a carefully planned fertiliser programme is needed. The rates of application will vary according to yield potential, which is dependent on variety, climate and irrigation, and to soil fertility dependent on soil type and land history. Soil fertility should be monitored regularly by soil samples taken at the same stage of the crop rotation six weeks after the end of the rains.

Approximate mineral nutrient of wheat grain and straw (kg/tonne)

Element	N	P	K	Ca	Mg	S	Zn(g)	Cu(g)
Grain	22	4.5	5	0.4	2.0	1.2	55	12
Straw	7	4.0	10	2.0	1.5	1.5	15	4

Generally, amounts of 2 to 3kgs N, 1.2 to 1.5 kgs $P_2 0_5$ and 1.5 to 2 kgs $K_2 0$ are usually considered necessary to produce 100 kilograms of wheat. With good irrigation management, little fertiliser will be lost by leaching or denitrification. The wheat crop is therefore able to respond very efficiently to fertilisation and excessive applications are unnecessary and wasteful.

The rates of nitrogen required will depend on yield potential rather than available-N and are based on area and water availability. The highveld (high yield potential) about 180-210 kg/ha nitrogen is required while middleveld (medium yield potential) and Lowveld (low yield potential)will need 150—180 kg/ha nitrogen and 130—160 kgs/ha nitrogen respectively.

For phosphorus and potassium, if the available soil status is marginal then rates of 50-70 kg $P_2 0_5$ per ha and 45-60 kg $K_2 0$ per ha are required. All the phosphate and potash and up to one third of the nitrogen can be applied initially on all soil types. On the sandy clay loams and clays all the nitrogen may be applied preplanting, provided the nitrate is not leached too deep by early irrigation to bring the profile to field capacity. With a close planted crop like wheat there is no advantage in band application of the compounds. The fertiliser is therefore broadcast and incorporated to a shallow depth up to 100 mm. With minimum tillage satisfactory results have been obtained by incorporating the fertiliser with the seed by shallow discing with the discs set to the most non-aggressive angle, or even by rolling.

As it is critical that the wheat has ample nitrogen in the early stages of growth and there is no yield advantage in late applications, all the nitrogen must be applied before booting. Infact, where split applications are recommended on lighter soils the first application should be at three weeks and the second one no later than the second node or growth stage 3.2 according to Zadocks scale. Evenness of application is as important as the amount and timing of top-dressing.