agriculture
& rural development
Department:
agriculture
& rural development
PROVINCE OF KWAZULU-NATAL

PASTURES IN KWAZULU-NATAL

Pasture Fertilisation

PHOSPHORUS, POTASSIUM, SULPHUR AND MICRONUTRIENTS

N Miles

INTRODUCTION

The majority of uncultivated soils in Natal are severely deficient in phosphorus (P) and have limited potassium (K) and sulphur (S) reserves. Successful pasture establishment, in general, is not possible without substantial fertiliser P inputs. In the long term, additions of K and other nutrients are required to maintain high pasture productivity.

The formulation of fertiliser recommendations for pastures presents particular difficulties. Pastures are propagated on a wide range of soils, including those considered unsuitable for arable crops. Between soils there are appreciable differences with respect to nutrient-supplying power. The situation is further complicated by the fact that, due principally to climatic variations, a relatively wide range of pasture species is of importance in Natal. Research and experience have shown that different species frequently exhibit marked variations with respect to their soil fertility and moisture requirements.

In practice pasture performance is clearly related to fertiliser nitrogen (N) inputs. An in-depth consideration of N requirements and management is contained in a separate leaflet (Natal Pastures Leaflet 2.3).

In Natal, pasture P and K requirements have for some time been based on soil analyses. An on-going pasture fertility research programme has resulted in a steady improvement in the quality of recommendations.

SOIL SAMPLING

The importance of sound soil sampling procedures cannot be overemphasized. Research both locally and overseas, has demonstrated that the failure to take a representative soil sample is invariably the largest source of error in the soil fertility evaluation programme.

General requirements for sound soil sampling are:

- Use a **proper soil sampler** (preferably the Beater type) and not a spade or some other implement to take the sample. The sampling bit should be made of stainless steel. On no account should metal objects be used to force cores out of the sampler.

- Take a **minimum of 20 cores**, but **preferably 40 cores per sample**. These cores are combined and mixed thoroughly prior to filling the standard soil sample carton. On no account should samples be oven-dried. Air-drying in a cool place, before packing, is permissible.

- It is essential that the **sampling depth** be accurately controlled. In the case of soil sampling **for pasture establishment**, the sampling depth should be **150 mm**. Sampling of already **established pastures** should be to a depth of **100 mm**. Sampling to greater depth usually results in grossly exaggerated fertiliser requirements.

- The size of the area from which a **single composite** sample is taken may vary considerably. Areas that differ in slope, drainage, soil types or past treatment should be sampled separately. It should never be assumed that the area enclosed by a fence constitutes a homogeneous unit. The selection of the area to be sampled must be based on practical considerations. Little is to be gained by dividing a field for sampling if the divisions are too small to be treated separately. Small areas suspected of being different, or known to be different, from other areas are best omitted from the sampling since a few cores from a problem spot, mixed with cores from the remainder of the field, may greatly influence the results of the tests. In the sampling of grazed pastures care should be taken to **avoid** visible **dung patches, areas close to water and lick troughs and lime "dump" areas.**

- Within the area to be sampled a **zig-zag sampling pattern** is preferable.

PHOSPHORUS (P)

Role in pasture nutrition

Phosphorus is severely deficient in virtually all uncultivated soils in Natal. From an economic point of view the correction of P deficiencies in pasture establishment programmes represents a major obstacle. Unlike N and K, P deficiency in plants is difficult to diagnose visually. For this reason reduced yields due to low soil P status are not always obvious, particularly under grazing.

Phosphorus plays an extremely important role in root development and hence in pasture establishment. Without adequate P supplies pasture establishment is slow and may even be unsuccessful where P is severely limiting. Research findings underline the folly of the approach, frequently adopted by farmers in the establishment of dry land pastures, of applying fertilisers, and P in particular, "only when establishment is successful". Furthermore, there would seem to be little justification for the practice of applying P in several split dressings rather than as a single dressing at establishment.

Phosphorus fixation

From a plant nutritional point of view, part of the fertiliser P applied to soils is converted to relatively unavailable forms. This conversion is called P fixation.

Phosphorus fixation is at a maximum in acid, red and yellow soils (*e.g.* Balmoral, Griffin, Clovelly) with a high clay content. Fixation commences immediately upon the application of P to the soil. With time more and more P is converted to unavailable forms. For this reason it is advisable to incorporate P in the **final** land preparation just before planting, and not a long time prior to planting.

A widely held view is that liming increases P availability. This is not supported by research findings. The lime may improve plant recovery of P through improved rooting but it does not increase P availability in the soil nor does it reduce P fixation.

It should be noted that in many cases high rates of P may be regarded as an investment since they tend to quench the soil's fixation capacity and thereby increase P availability in the long term.

Calculation of phosphorus fertiliser requirements

Research has revealed marked differences in optimum test values for the different pasture species. Furthermore, optimum P test values have been found to vary with soil texture. Soil texture, on the other hand, influences the amount of P required to raise the soil test by a single unit. These factors are taken into account in the recommendations provided by the Cedara Fertiliser Advisory Service.

Type of phosphorus fertiliser

Commercially available P fertilisers fall into two groups.

1. Highly soluble P fertilisers *e.g.* superphosphate, ammoniated supers, MAP.

2. Sparingly soluble P forms. The most important product in this group is rock phosphate. Rock phosphate has a total P content of 12 - 13 %. When compared with soluble P fertilisers on a **total P basis**, the P in rock phosphate is far less expensive than that in the soluble P forms. However, such a comparison is not strictly realistic since only a portion of the P in rock phosphate becomes available over a single season.

The considerations listed below should be borne in mind when selecting the P form to apply to pastures.

- The availability of rock phosphate is dependent on soil acidity levels. The more acidic the soil, the more rapidly the P (phosphorus) in rock phosphate becomes available for plant uptake. On the other hand, in soils with pH (KCl) values of more than 5,5, the long term availability to plants of P, applied as rock phosphate, is likely to be low.

- For successful pasture establishment it is advisable to supply a substantial portion of the recommended amount of P as soluble P fertilisers.

- Rock phosphate, in contrast to soluble fertilisers such as superphosphate, contains little or no sulphur. Therefore, where rock phosphate is the only or the principal P source used, periodic addition of sulphur, as ammonium sulphate or ammonium sulphate nitrate, is advisable in order to ensure an adequate sulphur supply for plant growth.

POTASSIUM (K)

Role in pasture nutrition

Potassium (K) and nitrogen (N) are the two nutrients utilised in greatest amount by pastures. The K and N contents of pasture grasses are frequently similar in magnitude. Potassium deficiencies restrict responses to fertiliser N and, furthermore, reduce the cold tolerance of pasture plants.

Potassium requirements are related to the method of pasture utilisation. Under "cutting-and-removal" type management (hay, silage, stall feeding of freshly cut grass) large amounts of K are removed and fertiliser K requirements are correspondingly high. Data presented in Table 1 provide an indication of the amounts of K removed by four pasture species at a relatively high level of production. In contrast to "cutting-and-removal", under grazing much of the K ingested is returned to the pasture in the form of excreta and fertiliser K requirements are therefore relatively low. Potassium requirements of pastures grazed by dairy herds tend to be intermediate between those for "cutting-and-removal" and permanent grazing since much of the K from the dairy animals is excreted off the pasture on roadways and in the milking parlour.

TABLE 1. Potassium concentrations in four pasture species and the potassium contained in 12,5 t dry matter of these species.

Species	K content %	K in 12,5 t D.M. kg
Italian ryegrass	3,0	375
Kikuyu	2,5	313
E. curvula	1,3	163
Lucerne	2,0	250

Practical experience, coupled with recent research findings, point to a delicate balance in the optimum K supply for intensive pastures. As indicated earlier, pasture productivity may be lowered by a shortage of K. On the other hand, where soil K levels are excessively high, grasses take up more K than is required for maximum dry matter production. This phenomenon, commonly referred to as "luxury consumption", may result in an unfavourable herbage mineral composition from the point of view of animal health.

Potassium fertilisation

Soil test K levels together with the management system imposed are the criteria upon which pasture K recommendations are based. Three categories of pasture management are recognised for the purpose of extending advice on K fertilisation.

Hay and/or silage making
The amount of K required for sustained high production of pastures used for making hay is frequently underestimated. Data presented in Table 1 provide an indication of K removal by various species at a medium-to-high level of production. Dry matter production, and therefore K requirement, are related to N fertilisation levels. In general, for hay crops at least 0,5 kg K is required for each kg of fertiliser N applied.

The amount of K required for sustained high production of pastures used for making hay is frequently underestimated. Data presented in Table 1 provide an indication of K removal by various species at a medium-to-high level of production. Dry matter production, and therefore K requirement, are related to N fertilisation levels. In general, for hay crops at least 0,5 kg K is required for each kg of fertiliser N applied.

One of two fertilisation strategies may be used to meet the K requirements of pastures used for hay or silage. In the first place, at the start of the season, soil test K levels may be raised to the target values and, depending on production achieved, a supplemental K dressing applied midway through the season. A disadvantage of this approach is that luxury consumption is likely to occur immediately after fertiliser dressings. The second and more sound strategy is to apply K in regular small dressings. Here the K could be applied with N topdressings.

Full-time grazing (animals on pasture for 24 h/day)
Where animals remain on the pasture more than 90 % of ingested K is returned to the pasture via the animal excreta. Depending on prevailing soil test K levels, long term fertiliser K requirements under continuous grazing are generally very low and may even be zero. Under this system of utilisation K applications in the absence of supporting soil test data are inadvisable.

Where animals remain on the pasture more than 90 % of ingested K is returned to the pasture the animal excreta. Depending on prevailing soil test K levels, long term fertiliser K requirements under continuous grazing are generally very low and may even be zero. Under this system of utilisation K applications in the absence of supporting soil test data are inadvisable.

Part-time grazing (animals on pasture for short periods)
Where animals are removed from the pasture at regular intervals, as in the case of dairy herds, an appreciable amount of K is lost in excreta deposited off the pasture. These losses must be compensated for in the fertilisation programme. A major difficulty here is the estimation of the amount of K lost to the pasture. Factors such as distance walked, period off pasture and the amounts and composition of supplementary feeds will obviously have a major bearing on the pasture K balance. Indications are that, in a single season, on irrigated ryegrass pastures, from 100 to 200 kg K/ha may be lost through excreta deposited off the pasture. In order to minimize luxury consumption and its attendant suppression of Ca and Mg in the grass, such losses must be corrected by periodic applications of K at a low rate.

Where animals are removed from the pasture at regular intervals, as in the case of dairy herds, an appreciable amount of K is lost in excreta deposited off the pasture. These losses must be compensated for in the fertilisation programme. A major difficulty here is the estimation of the amount of K lost to the pasture. Factors such as distance walked, period off pasture and the amounts and composition of supplementary feeds will obviously have a major bearing on the pasture K balance. Indications are that, in a single season, on irrigated ryegrass pastures, from 100 to 200 kg K/ha may be lost through excreta deposited off the pasture. In order to minimize luxury consumption and its attendant suppression of Ca and Mg in the grass, such losses must be corrected by periodic applications of K at a low rate.

SULPHUR (S)

Significant responses to sulphur (S) have been recorded on pastures in the Natal Midlands and East Griqualand. Sulphur uptake values of pastures are similar to P uptake values, with plant S concentrations usually falling in the range 0,1 to 0,3 % S. Indications are that S rates of the order of 30 to 40 kg/ha/annum are sufficient to meet the requirements of high producing pastures. Sulphur is conveniently supplied to pastures as superphosphate (10 % S), ammonium sulphate (24 % S) or ammonium sulphate nitrate (13,2 % S).

MICRONUTRIENTS

Zinc

Yield limitations in pastures due to micronutrient deficiencies are rare. While zinc deficiencies occur extensively in crops in the Natal Midlands, this does not seem to be the case for pastures. In trials conducted on a number of soils in the Midlands and Mistbelt, production of kikuyu, ryegrass and white clover was not affected by zinc additions. Soil samples submitted to the Cedara Fertiliser Advisory Service are routinely tested for zinc, and zincated fertilisers are recommended where the soil test is less than 1,5 mg/*l*.

Molybdenum

Molybdenum deficiencies have been found to limit maize production on almost all Natal soils. However, as in the case of zinc, pasture responses to molybdenum have not been noted in field trials. Molybdenum plays a particularly important role in symbiotic N fixation by legumes and for this reason

legume seed should be routinely treated with molybdenum (as molybdenum trioxide) before planting.

Other micronutrients

It appears unlikely that deficiencies of boron, manganese, copper or iron occur in pastures in Natal.