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7. Developing K manuring policies

The simplest approach to K fertilization is a balance sheet approach, i.e. replace all the K taken off in the crop. Such quantities can be calculated from known yields and tables of average composition of crops such as those used by Kali and Salz A.G. in Germany and the Agricultural Development and Advisory Service in England and Wales. Such a system is best on soils which contain sufficient exchangeable K that most crops are unlikely to respond to fresh K fertilizer. However, it does not allow for any added potassium moving rapidly into non-exchangeable and not immediately available forms, nor for any potassium which may be released from non-exchangeable reserves. If K is rapidly fixed by, or released from, soil then any manuring policy should allow for this but there is no rapid analytical method to measure such fixation and release. Some advisory systems do attempt to allow for soil type but only in a very unspecific way and yet soil type is clearly an important factor in the need to supply K fertilizer.

If soil is so light-textured and contains so little clay and organic matter that there is almost no ability to retain potassium in exchangeable and non-exchangeable forms, then K manuring should be on an annual basis. The amount applied should be sufficient to at least meet the expected removal in the crop and timing the application should aim to minimise leaching loss. It may well be that on such soils N and K could be supplied together.

On heavier textured soils, where appreciable amounts of potassium can be held in both exchangeable and non-exchangeable pools, soil fertility will be enhanced if K manuring exceeds K offtake in the crop. Such reserves should be accumulated to the extent that crops don't respond to added K fertilizer, and the K applied should maintain the soil K level. Such an approach has the advantage that the soil is enriched with K throughout the cultivated layer where roots are most active in taking up nutrients. On such soils there may be no need to apply K every year. A sufficiently enriched exchangeable pool, supported by residues and reserves will meet annual need. The pools of exchangeable and non-exchangeable K can be maintained by rotational manuring. The amount of K applied every few years should at least equal the amount of K expected to be taken off in the crops to be grown before the next application.

There are now two methods to check the validity of such manuring policies. The exchangeable K content of the soil can be monitored over time paying especial regard to always taking a truly representative sample from each field and maintaining a constant depth of sampling. If there is any doubt that the amount of exchangeable K is sufficient to meet the needs of the crop, then the crop can be sampled and the K concentration in tissue water determined. If the concentration is below that accepted as being sufficient for that crop then additional K should be applied.

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Estimation of Root Density in Modelling Nutrient Requirements

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Summary

Potassium (K) delivery to the roots of cereal plants in soils is determined by the following factors:

chemical and physical properties of the soil
climatological conditions (water stress) and
plant factors such as root growth and root density.

The phrase «root growth and root density» aims to establish an evaluative framework to determine the root density by which root penetration and intensity could be characterised through easily measurable factors.

In the first part of this paper, a method is presented for sandy and loamy-silty soils, by which the root density of cereals can be calculated on the basis of available field capacity, soil depth in 10 cm steps, and the climatic water balance.

A good correlation ($r^2 = 0.86$) was found when the root densities were determined at ear emergence. With the help of correction functions root densities can be subsequently estimated for the other phenological stages (stem elongation, flowering and yellow ripeness). The method described is suited for determining root densities in water and nutrient transport simulation models.

In the second part of this paper, a computer model for the simulation of potassium delivery is presented. Calculations for different root densities, and climatological conditions, have been carried out, to demonstrate the potassium delivery from the subsoil.

1. Objectives

For the simulation of the supply of potassium and phosphate to the roots through diffusion, data for several root parameters are needed (Jungk and Claassen [1986]). Depending on the mathematical basis of the model, root radius, root length and/or density L_v ($\text{cm} \cdot \text{cm}^{-3}$), and the root surface area are the relevant factors (Wessolek and Gäth [1989]; Claassen et al. [1986]; Grimme et al. [1971]). However, measurements of root length are tedious and time-consuming. For this reason, an evaluative framework was established on the basis of the results from numerous root studies, to determine the root length densities (Meuser et al. [1987]). This evaluative framework should enable users of the model to rely on average root length data in the absence

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