The use of lime in soil: Acidity is no longer invisible

By Dr Pieter Haumann, CEO, Fertiliser Association of Southern Africa

Although potatoes are preferably cultivated in acidic soils, it may sometimes be necessary to apply lime when excessive acidification has occurred. It is then essential to determine exactly where the soil has acidified and requires liming. The principles applied in the predominantly maize-producing areas of the central Free State's sandy soils can also be applied to soils used for potato production.

Determining lime requirements

There are many methods used for determining the lime requirement of soils. Some of these, such as the Natal method, the Eksteen method which was developed in the Western Cape, and the pH % clay tables, are outlined in the Fertiliser Association of Southern Africa's (Fertasa) *Fertiliser Handbook*.

It is generally found that the incubation method is the most accurate, especially if the lime to be applied is used in the incubation. It is, however, relatively time-consuming to carry out (*Fertiliser Handbook, [7th Revised Edition 2016]*). The method for determining lime requirements must provide reliable and repeatable values to a specific soil depth.

Follow-up sampling has shown that in practice, liming frequently fails to obtain the intended soil acidity level with the first attempt. It is important to determine why this is so. The reason can be as simple as any of the following:

- The correct amount of lime was not applied. Care should be taken that the application apparatus is correctly calibrated and that the application pattern is adhered to, ensuring that the specified amount of lime is applied.
- The correct amount of lime was applied, but the specified depth of incorporation in the soil was not adhered to. The lime would therefore have been 'diluted' with more soil than intended.
- The amount of lime was incorrectly calculated due to a faulty assumption regarding the bulk density of the lime and/or the soil.
- The lime requirement was determined on soil samples that were not representative of the targeted soil profile.
- The lime used had a lower neutralisation value than had been indicated by the producer or salesman.

Whatever the reason, the result is that the soil acidity level was not adjusted correctly. This can lead to maize crop yield losses due to under-liming. Of course, over-liming can obviously also be a problem. For potatoes, the goal may be different than for maize, but the same principles can be applied.

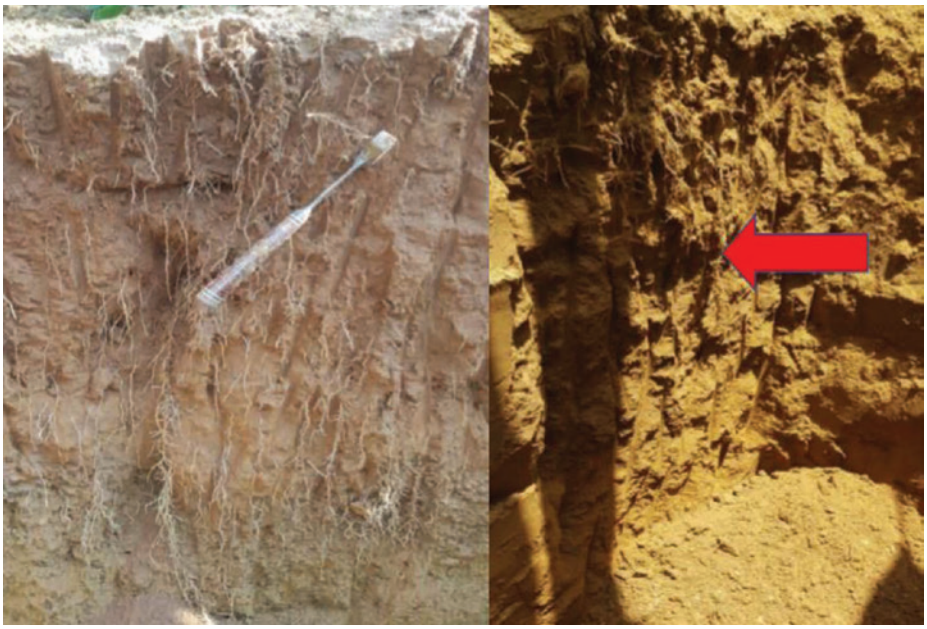
It has been shown that under-liming for maize production over a long period occurred on the sandy soils of the Free State and North West provinces (Van Zyl and Bornman, 2019).

A different approach

The approach for potato production will be different, since potatoes prefer lower pH levels than maize, for instance. Actions to prevent under-liming from occurring are the following:

1. Effective soil sampling. This must be followed up with further inspection of the land in the following way: Profile trenches should be dug to determine whether root growth has been negatively affected. The whole soil profile should be inspected, sampled and the samples analysed (*Figure 1*).

Figure 1: A soil profile inspected to determine root development. (Source: Kobus van Zyl, 2020)



A steel plate used to take soil samples. (Source: Jan du Toit, agricultural advisor, Omnia)

A grid pattern of soil samples taken. (Source: Jan du Toit, agricultural advisor, Omnia)

2. Some researchers use a steel plate of approximately 60 cm with six hollow square sections of 10 x 10 x 10 cm each. The steel plate with the cups is forced into the sides of the profile trench using either hammers or a hydraulic press. In this way, six samples can be taken at the same time (*Photos 1* and *2*).
3. An analysis of these samples gives insight into the distribution of soil acidity, as shown in *Table 1*. Although this method provides a clear picture of the distribution of soil acidity, it is only possible to do so after the soil samples have been analysed. It is not visibly clear in the field.

Soil colour indicating the pH after treatment with a universal indicator. (Source: Chris Gazey, 2014)

The efficiency of deep incorporation of lime. The purple colour indicates a high pH and lime that has not fully reacted with the soil and zones where lime has been cultivated deeply after application on the surface. (Source: Chris Gazey, 2014)

Perhaps the most visibly clear method to show the pH level in different zones on the farm is used in Australia, namely by spraying a universal pH indicator directly onto the soil (*Photo 3*). The topsoil has a greenish colour indicating a pH (H_2O) of > 5. The relatively thick layer of soil directly below has a yellowish to orange colour, indicating a pH (H_2O) of < 5.

Table 1: The pH (KCl) of soil samples of maize taken in a grid pattern. (Source: Jan du Toit, agricultural advisor, Omnia)

pH (KCl)						
4.96	**4.83**	**5.12**	**5.24**	**4.90**	**4.90**	**4.76**
6.23	6.56	6.48	6.53	6.36	6.35	5.1
5.33	5.06	5.31	6.21	5	5.03	5.38
4.61	4.4	5.18	4.68	4.48	4.42	4.52
4.11	3.92*	4.17	4.16	4.13	4.16	4.09
4.52	4.23	4.47	4.62	4.55	4.53	4.71
3.5 – 4	**4 – 4.5**	**4.5 – 5**	**5 – 5.5**	**5.5 – 6**	**6 – 6.5**	**> 6.5**

**The acidified zone is the result of pre-planted nitrogen fertiliser and is situated at a problematic depth of 40 cm.*

Purple colouring resulting from lime that has been cultivated in deeply. This indicates uneven mixing of lime with acidic soil, which will be restrictive to root development. This method would, however, not be as effective on strongly coloured soils. (Source: Chris Gazey, 2014)

This zone would be suitable for potato production. This would not have been detected by only sampling and analysing the topsoil. The soil located deeper than this layer has a greenish colour, indicating a pH (H_2O) of above five. This method is very useful as it enables rapid assessment of the acidity status of the soil on site.

The actual soil pH would, however, have to be verified by sampling and analysis. This useful, practical method can also be used for evaluating the efficiency of deep cultivation of lime (*Photos 4* and *5*).

In conclusion

Effective liming of soils can only occur after a thorough inspection of the soil profile and analyses of specific layers in the soil. The inspection methods described in this article will certainly enable producers to be in control of soil acidity and liming on the farm. The management of soil acidity can only be effective if all zones of acidity are identified and managed according to requirements.

For references or enquiries, contact the author at 012 349 1450 or send an email to general@fertasa.co.za.
For a guide to using a universal indicator on soils, visit *https://www.youtube.com/watch?v=RPFymigbCAs*

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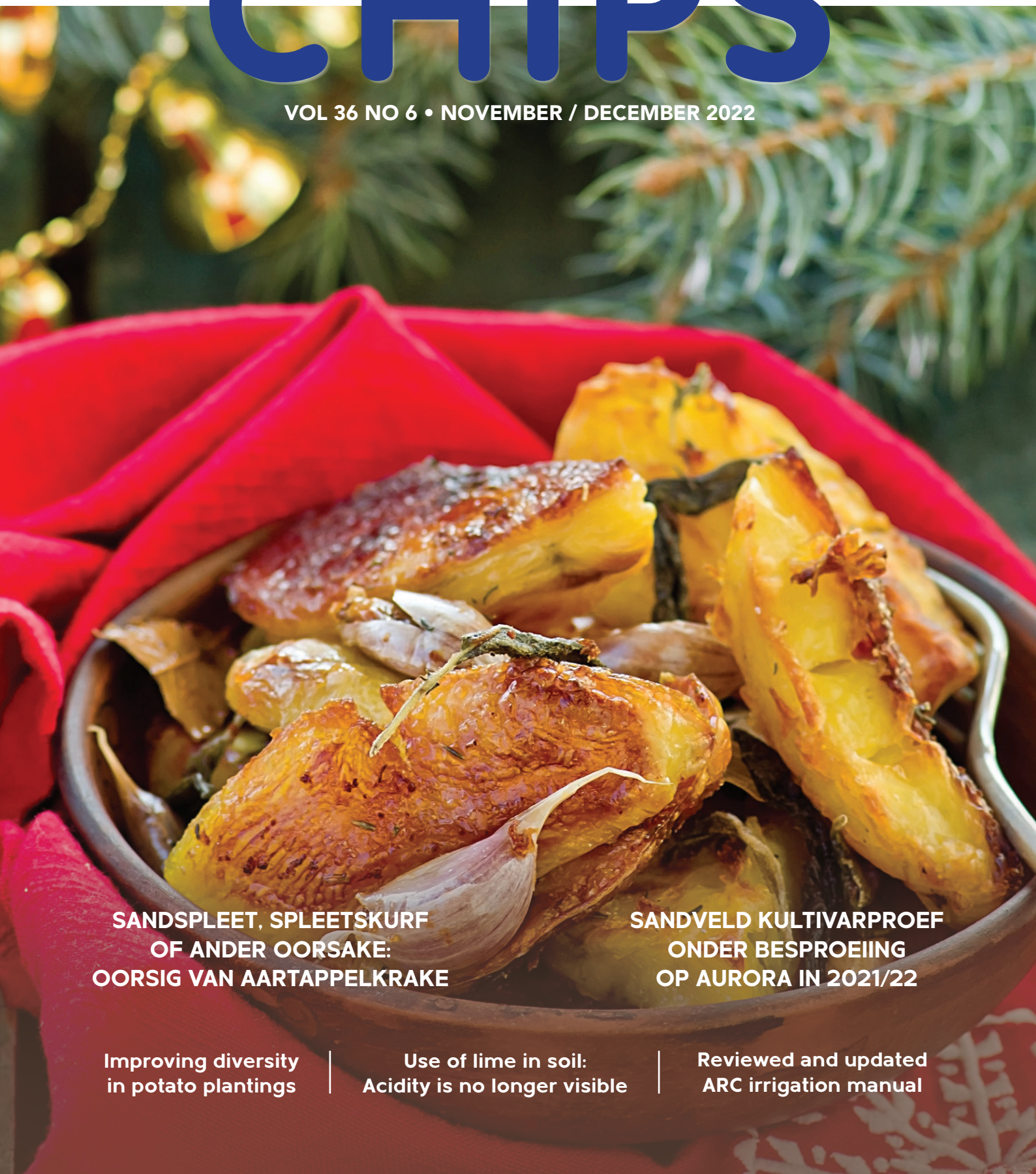

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