

FERTILIZERS

Ideally, fertilizer recommendations should be based on the results of recent soil analysis done on representative soil samples. Where vegetable crops are to be grown for the first time, or only sporadically, or on "virgin" soil, the importance of submitting representative soil samples for analysis and recommendations has to be emphasised. Analysing the soil before planting each crop, or at least annually, is recommended. Any obvious or serious nutrient deficiencies or imbalances may then be corrected before planting, and any lime required could be applied. Where vegetables have been grown intensively for some time with heavy fertilization, the soil nutrient status is likely to be more satisfactory. While annual soil analysis would still be beneficial, submitting soil samples for analysis every two or three years may be adequate. The objectives of such analyses are to correct imbalances of the major nutrients and to economise on fertilizer costs by applying only what is required for the following crop. Notwithstanding the above, many crops are grown without the soil being analysed. A general fertilizer recommendation is then necessary.

In high rainfall areas, soils tend to be inherently infertile and rather acid. Liming should be considered. Because of leaching, or else non-availability of fixed elements, fertilizer requirements are also likely to be high, unless intensive cropping with adequate fertilization has been practised for some time.

In drier areas, lime and potassium are less likely to be needed in large quantities, if at all, but phosphorus will probably be deficient in virgin soils. Where this inherent phosphorus deficiency has been corrected by high phosphate dressings, the fertilizer requirements are expected to be relatively low.

Taking the above factors into account, an attempt has been made to give general fertilizer recommendations which cover the expected nitrogen, phosphorus and potassium requirements of the crops dealt with later. One recommendation is made for the situation where soil fertility is likely to be high - for example, a history of intensive cropping with good fertilizer practices - and the other where the soil fertility is expected to be inadequate. Obviously, on very poor soils, crop results would be improved by even higher fertilizer rates.

These recommendations should ensure good average yields. However, higher applications may be necessary for very high target yields, and having soil analysed would then be essential.

Liming

Due to the comparatively high rainfall in KwaZulu-Natal, most of the soils are naturally acidic. Under such conditions aluminium and manganese toxicity may occur, and many nutritional elements are not easily available to plants. Such soils require liming for satisfactory plant growth and yield. Many fertilizers, particularly nitrogen carriers, tend to acidify soils. The only method of determining the kind and quality of liming material to apply, is by means of soil analysis.

Liming is done primarily to correct soil acidity, although it has a plant nutritional function in supplying calcium and magnesium. Dolomitic lime, which has a higher magnesium content than agricultural lime, is used where soils are deficient in Mg, whereas agricultural lime is used in other instances. For sub-soil acidity problems, gypsum, which is partly water soluble, is applied to the top-soil and washes down to where it is needed.

Lime does not move through a soil to any great extent and will basically stay where it is placed. It is thus very important to mix the lime thoroughly with the soil, and to incorporate it as deeply as possible. This is generally best achieved by broadcasting half the required amount and discing it in, followed by ploughing it down deeply. The other half is then broadcast and disced in.

The reactions caused in the soil by liming may take several months to be completed. Liming should thus be done at least a month, and preferably longer, before planting. In intensive vegetable production, and because many of these crops are short-lived, the full benefits of liming may not be seen on the first crop planted, but will obviously benefit those that follow.

With a few exceptions, such as potato and sweet potato, most vegetable crops require soils with no or very low acid saturation. Periodic and adequate liming is thus a very important practice in intensive vegetable production in most areas of KwaZulu-Natal. In fertilization, the application of three macro-nutrients, viz. nitrogen, phosphorus and potassium, are mainly considered.

Nitrogen (N)

At least half to two-thirds of the N requirement should be applied at planting, with the remainder being given as one or two side-dressings during growth. On many soils all of the N may be applied at planting, but then there is always the risk of leaching losses, particularly on the more sandy soils, following heavy rain or rain shortly after an irrigation.

In normal practice the basal nitrogen dressing at planting is often supplied with all the phosphorus and part or all of the potassium requirement, in the form of a ready-made fertilizer mixture, such as 2: 3: 4 (30), or 2: 3: 2 (22), both of which are very popular with many vegetable growers. At the rates generally used to satisfy the P requirement on reasonably fertile soils, these mixtures may supply too little N at planting, and would need to be supplemented with one of the principal nitrogen fertilizer materials. Such materials include limestone ammonium nitrate (LAN), which contains 28 % N and, incidentally, also about 5 % Ca, urea (46%N) and ammonium sulphate (21 % N and 24 % S). Of these, LAN is the most popular and least acidifying, and is used extensively for both basal and side-dressing. Potassium nitrate (KNO_3) is sometimes used, usually as a side-dressing, where K as well as N needs supplementation. These N fertilizers are all water-soluble and are thus very effective when side-dressed. However, they are, therefore, also fairly easily leached to below the rooting zone of the crop, especially on the sandier soil-types.

Phosphorus (P)

As with lime, phosphorus does not easily move in soils, and remains where it is placed. For this reason it must be applied at planting and must be worked into the root zone of the crop. It has virtually no effect when used as a top-dressing on relatively short-season vegetable crops. Under acid conditions, and to some extent also under alkaline conditions, phosphorus combines with other elements in the soil, and much of it becomes locked into insoluble compounds and is not easily available to plants. Liming assists in reducing this fixation of P. So does band-placement of P fertilizers, because less of the P in the band is actually in contact with the soil elements causing this reaction.

Apart from application in the form of fertilizer mixtures, as mentioned under nitrogen, the main P-carrier used in vegetable production is superphosphate (10,5 % P). The fertilizer has a high concentration of water-soluble phosphorus, which is important for quick uptake of the element by the relatively short-season vegetable crops. It also contains about 20 % Ca, 1 % Mg and, importantly about 12 % S. MAP (11% N, 22% P) and DAP (18 % N, 20 % P) are popular P-carriers because they are less expensive sources of P than superphosphate.

Potassium (K)

Most, if not all, of the potassium can safely be applied at planting, except on very sandy soils, where it can easily be leached to below the plant roots. All the K-carriers commercially available are highly soluble, and may, therefore, also be applied as side-dressings when necessary. They are considered to be equally effective sources of K. Muriate of Potash (KCl), containing 50 % K, is currently by far the least expensive and the most widely-used source of K. For certain crops, such as potatoes, especially for chipping, and tomatoes, the chlorine content of this fertilizer is thought to adversely affect quality. More expensive potassium fertilizers, such as potassium sulphate (40 % K and 18 % S), or potassium nitrate (38 % and 13 % N), are the alternative commercial K fertilizers.

Other elements

Apart from zinc, the normal soil test done at Cedara does not include the trace elements, nor sulphur. Special tests can be requested to determine whether or not these are in sufficient supply.

Should deficiencies of these be encountered in vegetable production the following chemicals may be used early in plant growth at rates as recommended by Cedara or an agricultural advisor:

Sulphur(S) - Where S is deficient simply use sulphur-containing fertilizers, such as ammonium sulphate, super phosphate and/or potassium sulphate, as sources of N, P and K, in the general fertilizer programme used.

Zinc (Zn) - Select for use the appropriate fertilizer mixture or the superphosphate to which Zn has been added. Zinc oxide at about 1 kg per hectare as a foliar spray may also be used.

Boron (B) - Boron deficiencies may be corrected by applying borax to the soil. More commonly Solubor is applied to the plants as a foliar spray at rates of about one to three kg per hectare. Particular care should be exercised in the application of boron as there is a narrow range between deficiency and toxicity.

Molybdenum (Mo) - Sodium molybdate or ammonium molybdate at 125 grammes per hectare is applied as a foliar spray. If needed, this can be followed up with a second spray of 60 g of the material.

Iron (Fe), Manganese (Mn) and Copper (Cu) - Foliar sprays with iron sulphate or chelate (1% solution), manganese oxide (2 to 3 kg) or 5 kg/ha manganese sulphate and copper oxychloride are used, should these elements be deficient.

Fertilizer mixtures

As previously mentioned, various fertilizer mixtures are quite popular for basal fertilizer applications in vegetable crop production. These materials are manufactured to contain at least two of the three main nutrients. Each mixture is differentiated from any other by differences in the four numbers used in its name, e.g. 2:3:4 (27), 1:0:1 (29), 0:2:3 (25), and so on. The first number always refers to the ratio of nitrogen (N), the second to the ratio of phosphorus (P) and the third to the ratio of potassium (K) - always in this order - to the total of the three elements. The fourth number - in brackets - denotes the total percentage (%) of nutrients in the mixture, i.e. the sum of N plus P plus K, expressed as a percentage of the mixture.

A mixture such as 2:3:4 (27) would thus have 2 parts N, 3 parts P, and 4 parts K, i.e. a total of 9 parts nutrients, all amounting to 27 kg nutrients for every 100 kg of fertilizer mixture. Therefore, two ninths of 27 kg, or 6 kg, of every 100 kg of mixture would be N.

Similarly three ninths of 27 kg, or 9 kg, would be P, and four ninths of 27 kg, or 12 kg, would be K. Thus, 6 kg N plus 9 kg P plus 12 kg K, a total of 27 kg nutrients, would be present in every 100 kg of 2:3:4 (27) fertilizer mixture.

Similarly, 0:2:3 (25) mixture would contain 0 parts N, 2 parts P and 3 parts K, a total of 5 parts nutrients, with 25 kg of nutrients in every 100 kg of the mixture. This mixture would thus contain no N, two fifths of 25 kg, or 10 kg, P and three fifths of 25 kg, or 15 kg, K in every 100 kg of the mixture.

Because zinc (Zn) is often deficient in KwaZulu-Natal soils, this element is sometimes added to superphosphate or some of the fertilizer mixtures. If this has been done, the symbol Zn, as well as its percentage (usually only 0.5, 1.0 or 1.5 %) is added at the end of the fertilizer name or number.

Soil testing

Much mention has been made of basing lime and fertilizer recommendations on the results of a soil analysis. Bear in mind that the soil test is done on only about a teaspoonful of soil, and this may represent a whole field of several hectares. It is thus clear that the soil sample submitted for testing should be as representative of the land as possible.

The following points should be noted when taking soil samples:

- a single sample should not represent too large an area - normally only up to 5 or 10 hectares.

- such an area should be as uniform in appearance as possible, i.e same colour, depth, texture, etc.

- if possible, use a Beater soil sampler, which takes uniform cores to a depth of 15 cm - consult the KwaZulu-Natal Department of Agriculture and Environmental Affairs.

- walk in a zig-zag or criss-cross pattern over the whole field, taking a sub-sample at say every thirtieth step.

- take 20 to 30 sub-samples (cores) scattered randomly over the field.

- in taking sub-samples, avoid non-representative areas where possible, e.g. the previous year's fertilizer bands, where fertilizer or lime was stacked or leaked, small patches of soil, which are different in appearance and which are not worth treating separately, and so on.

- mix the sub-samples thoroughly on a clean bag or area, and re-sample from this for the final sample to be submitted to the laboratory.

- ensure that the sample is never contaminated by any container possibly containing nutrients, e.g. old fertilizer bags. Always use clean containers.

- supply the laboratory with any other information that may be relevant, e.g. previous crop grown, its fertilizer programme, crop results.

- submit the final sample with the required fee, and in the carton provided, together with the relevant completed form and other information to the Soil Testing Laboratory at the College of Agriculture, Cedara. This can be done via the local extension officer or agricultural adviser.

Organic manuring

So far the use of inorganic fertilizer has been discussed. This has been done, not because these are preferred, but because natural organic fertilizers such as kraal, pig and chicken manure, guano, sewerage sludge and composts account for a very small percentage of fertilizing materials available and used in KwaZulu-Natal. Most growers simply have no ready supply of these bulky materials, which may be needed at rates of five to eight tons for a fairly concentrated material such as chicken manure, to 20 or 30 tons for composts on each hectare planted to each crop. The logistics, cost and even availability of such vast quantities of material

make their sole use impractical for most growers.

There is no denying the great benefits of using such materials, and all growers should make some effort at least to supplement their inorganic fertilizers with composts or manure. If fairly heavy dressings are used, the rates of inorganic fertilizers applied may be adjusted, but for relatively light applications make no changes to recommended rates of fertilizers.

Organic materials will supply not only N, P and K, often not in quite the desired quantities nor proportions, but also other nutritional elements, including micro-nutrients. Compost made from plants grown in an area deficient in a certain element will itself tend to be deficient in that element. So also manures may be deficient in certain elements, depending on the feeds used for the animals concerned.

However, such organic manures have other benefits. They increase the micro-flora and other organisms living in the soil, to the benefit of the soil, and the crops growing in it. The higher organic content of the soil improves soil structure, and its water-holding capacity. Plants are also able to extract nutrients more easily from such soils.

Green manuring

Green manure crops are those which are grown for the sole purpose of ploughing them in. They improve the soil by supplying organic matter and, if legumes, also nitrogen, which has been fixed on their roots by nitrogen-fixing bacteria.

Vegetable crops grown within a year or so after a green manure crop has been ploughed in *do* benefit, and produce higher yields. However, the green manure crop is produced at the expense of another cash crop, which could have been grown over this period, and this practice may not make good financial sense, certainly not in the short term.

Sunnhemp, a legume which grows to a height of about 2 m, and thus produces large quantities of organic material, is one of the better known green manures. It is ploughed in while still green and before it has become very fibrous, so that decomposition is quite rapid and planting of the next crop need not be unduly delayed. Other crops such as Pearl Millet (babala), or any of the tall-growing forage grasses which produce a significant amount of plant material, may also be used. Ploughing down 50 kg or so of LAN with this material will hasten decomposition and allow earlier planting, unless soils are very cold.