IMPORTANT ASPECTS IN FERTILIZING VEGETABLE CROPS UNDER GLASS

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INTRODUCTION

About half of the total glasshouse acreage in the world is located in the Netherlands. The greater part of this half, namely 5,000 ha, is used for vegetable production. The most important crops are : tomatoes, annual turnover D. fl. 280,000,000; cucumbers D. fl. 113,000,000 and lettuce D.fl. 100,000,000 (1 million D.fl. equals about £ 100,000 or 1,300,000 French Francs).

In glasshouse cultivation the cost of fertilizers is only a small percentage of the total cost of production. However, it is of economic importance to apply the right quantity and kind of fertilizers as this makes a significant contribution towards higher yields and optimum quality of the product.

THE CLIMATE IN THE GLASSHOUSE

By erecting a glasshouse, the climate on that site is entirely changed and, as the natural rainfall is totally absent, it has to be defined as arid. However, the growers take steps to provide the crops with water. Sprinkler irrigation equipment is installed in nearly all glasshouses in the Netherlands. It is constructed from plastic or galvanised iron piping with nozzles at intervals of 1 to 3 meters. Opening the valves and pressing the button of an electric switch are sufficient to supply water in every part of the glasshouse. On many newly established nurseries with modern equipment the valves are controlled electrically and the water supply can be programmed electronically. This makes watering very easy and some growers use the system so freely that the glasshouse climate becomes very humid. Between the arid and humid glasshouse climates all gradations can be found, depending on the opinion of the grower, on the crop, the soil type and on the soil water level. The western part of Holland, with the world's largest glasshouse area the Westland, is flat and low. The water level is relatively constant at a depth of about 70 cm. The south-eastern part of the Netherlands, with a smaller glasshouse area of 500 ha near Venlo, is hilly with water levels which often fluctuate enormously.

In most glasshouses the soil is leached in the autumn in order

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to decrease the salt content of the soil. This again is done by sprinkler irrigation. The quantity of water necessary for leaching the soil was studied by the author (1964).

The formula $ln\ y = -kx + ln\ B$

in which y = salt content

B = initial salt content

x = quantity of water

k = constant factor

agreed well with the observed decrease in salt content.

For glasshouse cultivation it is necessary to have water of good quality available; even in Holland this is becoming an increasing problem. On the one hand sea-water penetrates inland from enlarged harbours and canals, whilst on the other hand it appears that the water of the rivers Rhine and Meuse is becoming increasingly polluted.

Another typical aspect of glasshouse climate is the carbondioxide content of the air. In many glasshouses, carbondioxide is enriched by burning paraffin-oil or natural gas, but even without artificial enrichment the content inside the glasshouse can be high owing to the mineralization of organic material. This is, of course, particularly the case if manures are applied in large quantities.

MANURES AND INORGANIC FERTILIZERS

As already mentioned, the cost of fertilizers forms only a small percentage of total expenditure. Although this does not hold true for the manures, they are sometimes used in large quantities. The cucumber is a crop reacting very favourably to the application of manures, and is often cultivated on strawbales. After preliminary treatment of the bales with nitrogen and water, the young cucumber plants are planted out on the bales. The roots run through the bales into the subsoil. In the case of cultivation on bales the quantities of organic material applied in this form alone comes to 2,500 kg per 100 m^2.

Besides straw, farmyard manure is often used for nutrition and soil improvement as also are spent mushroom compost, peat, town refuse and mixtures of these materials.

As there is a big demand, the trade in organic materials is well developed in the Netherlands. This is very important as it gives the growers the possibility to buy any required organic material at competitive prices. It was also possible to keep up with the change from solid to liquid manures that takes place on cattle farms in connection with the mechanical removal of the faeces. The traders in manures have tank trucks at their disposal which transport the liquid manure (slurry) and can distribute it wherever required in the glasshouse. To the growers, this is a labour saving procedure as they are spared the task of wheeling in the manure.

The growers in Holland can purchase all kinds of inorganic fertilizers such as potassium nitrate and triple superphosphate, which are seldom used in agriculture but are desirable for glasshouse purposes as they are highly concentrated and contain no "ballast,,.

ANALYSIS OF GLASSHOUSE SOILS

Variations in the application of manures, in their nutrient content and in the use of sprinkler irrigation can lead to marked differences in the content of certain soil nutrients. Furthermore, growers are inclined to apply as much fertilizer as possible. For these reasons it is desirable to have the soil analysed during cultivation. The danger of over-fertilization and salinization makes some special forms of soil analysis necessary. In addition to the determinations normally made in outdoor soils, glasshouse soil samples, taken before glasshouse cultivation, are analysed for water soluble nitrogen, total salts (conductivity measurement) and chloride. The determination of chloride content is especially useful in flat areas near the sea coast, where the water is often brackish.

A so-called short analysis is made for determining the amount of top-dressing. In this analysis the total salt content is determined, together with water-soluble nitrogen and potassium.

Water is most popular extractant for glasshouse soils in the Netherlands, although it has not been definitely established that different extractants are inferior to water. It is important to keep the number of extractions to a minimum as this increases the speed of the analytical procedure. To the grower, the speed of the analysis is at least as important as the accuracy.

From experiments and practical experience, the determination of readily soluble nitrogen has been found to be particularly valuable for glasshouse soils. Probably a great number of crops, at least lettuce, tomatoes and cucumbers, have the same optimal value, namely about 100 ppm N in dried soil.

TYPICAL ASPECTS OF THE FERTILIZATION OF LETTUCE, TOMATOES AND CUCUMBERS

LETTUCE

On commercial nurseries nitrogen and phosphate are the most important nutrients. The quantity of nitrogen to be applied depends on the leaching of the soil. Since lettuce are susceptible to high salt content in the soil, and are cultivated in rotation with tomatoes or cucumbers which are often heavily fertilized, the soil is generally leached before cultivation. If the soil is leached well, no water soluble nitrogen is to be found and 2 kg N per 100 m^2 are necessary for lettuce. Where the soil is leached for only a short time, the nitrogen content may be high or low and the nitrogen dressing must be adapted to the soil analysis.

The quantity of phosphate to be applied can range widely viz. from O to 10 kg P_2O_5 per 100 m^2. In new glasshouses, large amounts of phosphate should be applied, whereas in old glasshouses hardly any is necessary. This difference can be explained by the immobility of phosphate in the soil and by the large quantities of phosphate applied in fertilizers and manures, leading to rapid accumulation of this nutrient in the soil.

TOMATOES

For tomatoes it is particularly nitrogen and potassium which are of importance. Phosphate is less important for tomatoes than for lettuce. Tomatoes respond less obviously to phosphate

and the quantity to be applied is smaller. In estimating the optimal application of inorganic phosphate, the phosphate effect of the farmyard manure must be taken into account for tomatoes, whereas this is not the case for lettuce.

Nitrogen has a great influence on the growth of the tomato crop and hence on yields. The influence of nitrogen on fruit quality was found to be different in several trials, and unfortunately cannot be predicted at this moment. Nitrogen influences the occurrence of fungus diseases, shortage of nitrogen making the plants more susceptible. The optimal quantity to be applied varies greatly, depending on the readily soluble nitrogen content of the soil and also on the soil type. It ranges from zero at high nitrogen levels in the soil to 6 kg N per 100 m^2 on heavy soils with low nitrogen content. The influence of soil type is as follows : on clay or loam a large amount of nitrogen is necessary as base-dressing and little or none as top-dressings; on light, sandy soils a small quantity is required as base-dressing, while a large amount has to be given in top-dressing, at frequent intervals.

Potassium influences growth and yield only if the potassium status of the soil is very low, but the influence on quality is remarkable. In order to obtain the highest yield of evenly coloured fruits, a larger amount of potassium is needed than for the maximum yield.

CUCUMBER

In the Dutch glasshouse industry it is common practive for growers to apply large quantities of manures for the cultivation of cucumbers. The amounts of nutrients supplied by the manures and other organic materials mostly exceed the uptake by the crop (Roorda van Eysinga and Van Haeff 1964). As a consequence one must expect, and this expectation was proved by experiments, that if organic materials are used then little or no inorganic fertilizer is necessary.

Nitrogen is probably the most important of the nutrients from a practical point of view, but for reasons already given it is difficult to demonstrate this. Deficiency and excess of nitrogen influence the quality of the cucumber fruit. In both cases the fruits are smaller, and more fruits with under-developped ends may occur.

CONCLUSION

Fertilizers have an important influence of the yield and quality of vegetables cultivated under glass. Soil analysis before and during cultivation may ensure that the soil has the optimal nutrient status.

For the grower it is important to work in a glasshouse area where all the required materials can be purchased at competitive prices. An active glasshouse centre encourages technical progress; and also ensures that the growers there can more readily keep abreast of recent developments.

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