Commercial vegetable growing in the Perth metropolitan region

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MARKET gardening with sprinkler irrigation on deep sandy soils around Perth is really a commercial application of hydroponics or sand culture principles. Provision of a continuous and adequate supply of nitrogen is the major problem. Peat swamps scattered among the sandy areas have higher natural fertility. However, their common problems are drainage, acidity ("sourness"), salt and various special soil deficiencies. Over-liming of acid swamps can cause new problems.

Market gardening around Perth since the early days of settlement was concentrated in swampy areas, where a permanent shallow water table offsets the lack of rain during the dry summer period. With the introduction of sprinkler irrigation it moved on to the sand country until today it is estimated that only about 10 per cent. of the market gardening in the Perth area is confined to the swamps without irrigation.

This preference for coastal sand country is due to the ease with which good quality irrigation water can be obtained at shallow depths, the availability of electric power for pumping irrigation water, the proximity of the markets, cheaper cultural operations, freedom from frost, the cooling effects of summer sea breezes, rapid soil warming in the early spring and the better control of factors affecting growth conditions.

This shift has involved a greater use of fertilisers. Over the years many fertiliser investigations with vegetables have been undertaken but results, of necessity, must be discussed in general terms.

1. COASTAL SANDS

These soils are inherently very infertile but under sprinkler irrigation and proper manurial treatment they can be made to produce, under our climatic conditions, high yields of good quality vegetables. It has been said that in this type of vegetable culture the sand acts mainly as a support for the plant. As the food and water requirements of the crop are supplied without depending on the fertility of the soil or the natural rainfall, it is in effect a large-scale commercial application of the principles of hydroponics, or sand culture.

The coastal soil types used for vegetable growing have been described by Smith (1). The Cottesloe association is used most extensively, the Karrakatta association to a much lesser extent and the Bassendean association to a very limited extent. Factors other than soil fertility appear to be mainly responsible for this preference.

The cost of installing sprinkler irrigation is fairly expensive. The cost of electricity for pumping irrigation water has
been estimated at about £16 per acre per crop. The total fertiliser cost per acre per crop would be in the vicinity of £75 to £100. Although it is certain that some saving could be made in fertiliser costs growers are not inclined to depart from fertiliser practices which by experience have proved successful.

Most of our early fertiliser experiments with vegetables on sand country resulted as a consequence of the impact of fertiliser rationing during World War II. At that time certain basic principles were elucidated (2). Since then may specific problems have been investigated. There is still great scope for the investigation of trace element deficiencies and toxicities, organic manure substitutes, economy in fertiliser costs and optimum irrigation rates.

Our present state of knowledge can be concisely tabulated as follows:

**ORGANIC AMENDMENTS**

It is known from the results of soil-less gardening that we can grow vegetables by the continuous feeding of complete chemical fertilisers. The question therefore arises whether it is essential to use bulky organic manures. Local practical experience has shown that to obtain high yields and first quality vegetables on sand country it is safer, simpler and cheaper to combine the use of a bulky organic manure like horse manure with the addition of the more concentrated and more soluble mineral fertilisers such as superphosphate, sulphate of ammonia and muriate of potash. It is usually accepted that organic amendments play their part in intensive gardening by:

1. Supplying a continuous source of plant foods which are not easily leached out by rainfall or irrigation.
2. Limiting the leaching of added mineral fertilisers.
3. Improving the physical conditions of the soil.

Whatever may be the theoretical approach to this question the grower accepts the use of organic amendments as an essential part of his fertiliser programme for sand country.

In the past, horse manure at about 10 tons or more to the acre had been used extensively for this purpose. Horse manure is now scarce and expensive and it is necessary to find a suitable substitute. Such materials as sewage sludge, fowl manure, sheep manure, wool scouring waste, barley combings, spent hops, brewer’s grains, etc., have been used.

Recently experiments have been commenced on the use of peat as a soil amendment (3). Results to date suggest that peat can be used as a substitute for horse
manure provided additional mineral fertiliser is used. Suitable large peat deposits are found adjacent to the market gardens and its occurrence lends itself to large-scale mechanical digging.

**NITROGEN**

The provision of a continuous and adequate supply of nitrogen under conditions of severe leaching from rain or excessive irrigation is the major problem. Organic manures such as blood and bone and fowl manure are used to provide a continuous supply of nitrogen which is less liable to be leached from the root zone.

The soluble nitrogenous fertilisers such as sulphate of ammonia and nitrate of soda are easily washed out of the soil and unless split applications are practised the crop will suffer from nitrogen starvation. Usually three separate applications of soluble nitrogenous fertiliser are used.

It is reasonable to assume that greater economy of soluble nitrogen fertilisers could result if the number of applications were increased and if the quantities applied at each stage were adjusted to coincide with the demands of the growth curve. Excessive irrigation or heavy winter rainfall can increase the amount of soluble nitrogenous fertilisers required. Growers use blood and bone manure at up to 30 cwt./acre and nitrate of soda or sulphate of ammonia at up to 10 cwt./acre.

**PHOSPHORUS**

Probably because of the large amounts normally applied and the additional use of bulky organic manures the leaching of superphosphate by irrigation or winter rain does not apparently present a practical problem. It is usual to apply 5 cwt. or more of superphosphate per acre and these amounts may be applied in one dressing or in three split dressings without affecting yields. Some cauliflower and cabbage growers use up to 1 ton of superphosphate to the acre. Very little work has been done on minimum phosphate requirements or the possible greater efficiency of split dressings.

**MAGNESIUM**

No authenticated case of magnesium deficiency is known, although several suspected cases have been investigated with negative results. Considering the soil conditions this is puzzling. Many growers use Epsom Salts as a precautional measure. Also many organic manures are relatively good sources of magnesium (4).

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Fig. 2.—After ploughing, the newly-ploughed land is spread with spent hops which are then rotary-hoed into the soil, before planting takes place. Portion of this paddock is shown planted with cauliflowers. Note the typical tuart vegetation and the limestone outcrops.
SULPHUR

Sulphur deficiency in market gardens has not yet been definitely recognised. On one occasion it was induced experimentally with a crop of cauliflowers by the sole use of a complete soluble commercial fertiliser which contained practically no sulphur. Typical symptoms were obtained and plant analysis confirmed the diagnosis. A dressing of superphosphate quickly corrected the symptoms.

In practice the use of superphosphate and other sulphur-containing fertilisers appear to ensure that sulphur deficiency does not occur even with the more susceptible crops such as cauliflowers and cabbages.

IRON

Iron chlorosis is fairly prevalent among tomato crops. Some chemical studies indicate that toxicities of copper, zinc, manganese and phosphorus either singly or combined are playing a part in inducing iron chlorosis. In these cases affected leaves have a much higher iron content than normal leaves. This form of iron chlorosis has responded quickly to 0.2 per cent. foliage sprays of iron chelate. Lime-induced iron chlorosis in tomatoes is not controlled by the same iron chelate spray.

TRACE ELEMENTS

Many growers apply “minor element mixtures” which are either ready-mixed proprietary lines or compounded according to what they consider are their own special requirements.

Considering that only two trace element deficiencies, namely manganese and molybdenum, have definitely been confirmed experimentally, the wisdom of using complete trace element mixtures is open to some doubt. The question of toxicities could be a future problem as a result of their use. The use of bulky organic manures does tend to limit the occurrence of trace element deficiencies. (4).

MANGANESE

Manganese deficiency is very prevalent with a wide variety of crops. A leaf content of less than 15 parts per million of manganese usually indicates that a response to manganese treatment could be expected. It occurs most commonly on limy soils. Soil applications of about 56 lb. per acre of manganese sulphate if
broadcast and 10 to 20 lb. per acre for row placement is one method of control. A more popular method is to use a 1 per cent. manganese sulphate foliage spray.

**MOLYBDENUM**

Molybdenum deficiency has been reported on cauliflowers, rockmelons and cucumbers. The three published methods of control namely seed-bed, fertiliser and foliage spray are all used. There is a tendency for some cauliflower growers to use repeated heavy soil applications of molybdenum. A case is known of an oat crop grown after several molybdenum treated cauliflower crops which had a molybdenum content which exceeded the safe limits for stock.

**BORON**

Although many cases of suspected boron deficiency have been investigated, especially in cauliflower and celery, it has not been possible to prove conclusively, either from fertiliser application or chemical analysis, that the symptoms observed were those of boron deciency. Many growers apply borax dressings.

**COPPER AND ZINC**

No proven cases of copper and zinc deficiency are known. This is hardly surprising in view of the widespread use of copper and zinc fungicides.

**IRRIGATION PRACTICES**

Crops grown on sand country are irrigated daily during the warm weather. The suggested optimum rate of application would be from 1/4 to 1/2 an inch daily. Some growers, apparently unaware of the leaching effect of excessive irrigation, use a much heavier daily rate than this. Excessive irrigation is particularly wasteful of soluble nitrogenous fertilisers. Under these conditions organic nitrogenous manures make for better growth than the use of soluble nitrogenous fertiliser. Rates up to 4 in. of water per day have been measured in market gardens.

**2.-PEATY SWAMP SOILS**

The permanently wet swamp soils found in depressions between the sand dunes within the Cottesloe, Karrakatta and Bassendean associations have been grouped by Smith(1) into the Herdsman association. Teakle and Southern (5) have reported on the extent and properties of these soils. For our purposes they can be conveniently placed in three main groups as follows:—

1. Peaty sands.
2. Acid peats.
3. Marly peats.

Some of these soils are highly productive for vegetable crops. The two main advantages of the swampy soils are their better fertility and that it is not normally necessary to instal costly sprinkler irrigation. Fertilisers, although not applied at the heavy rates used on the infertile sands are still of great importance and special problems are encountered. Split dressings are not used to the same extent as on sand country although soluble nitrogen fertilisers are often added as side dressings for such crops as cauliflowers and cabbages.

Any of the trace elements may assume importance and of these copper and manganese deficiency are most frequently encountered. Liming acid peats may induce certain trace element deficiencies and markedly increase the supply of molybdenum. Generally growers are not fully aware of the importance of adequate potash fertilisers on most of these soil types.

The special problems encountered are discussed below:—

**Soil Acidity.**

The acid peats and acid peaty sands usually respond to a dressing of lime of about 5 to 10 tons per acre when the soil pH is below 5. On one acid peat, applications of 1 to 2 tons per acre of lime did not have a beneficial effect on the vegetable crops and soil pH values had not been raised when sampled after harvest. However, calcareous beach sand at 10 tons per acre proved adequate. This beach sand contained 85 per cent. calcium carbonate and 5 per cent. magnesium carbonate.

There appears to be a seasonal fluctuation, in some cases, in soil pH values covering a range of approximately half a unit. During the winter the pH value is highest and during the summer lowest (i.e., most acid in summer.

Plants grown on acid peats may suffer from metal toxicities and manganese.
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excess is fairly common. Molybdenum deficiency causing “whiptail” in cauliflowers is very prevalent on acid peats and yet, after liming, the molybdenum content of the pasture plants may reach very high levels. On the more acid peats the root growth of vegetables and clovers is usually confined to the depth of influence of the applied lime and this may limit water and nutrient uptake.

While manganese toxicity can be a problem before liming, manganese deficiency is often induced after liming. Marly peats are very prone to manganese deficiency. The use of lime has induced the occurrence of “common scab” on potatoes and beetroot when soil pH was raised above 5.8. One grower has reduced “common scab” to reasonable proportions in potatoes under these conditions by the use of sulphur at the rate of 500 lb. an acre mixed with the fertiliser in the furrow.

Experience with acid peat soils has led growers to unconsciously select by trial and error such crops as potatoes, rhubarb and pumpkin which are more acid-tolerant.

Potash Deficiency.

Potash fertilisers can rarely be omitted in vegetable growing on peat swamps without the yield being reduced. It is essential that soil acidity be controlled and adequate drainage be provided before the most efficient use of potash fertiliser is obtained. Trials show that on a limed peat 2 cwts. per acre of muriate of potash was an adequate dressing while on unlimed acid peat even 4 cwts. per acre of muriate of potash gave only partial control of potash deficiency. Many examples are known where improved drainage has increased the uptake of potassium and removed potassium deficiency symptoms in pasture plants and vegetable crops. The symptoms were confirmed by chemical analysis.

A very common failing is that although potash is used it is not applied in adequate amounts. With “Potato Manures” containing 5 per cent. or 8 per cent. potash (K₂O) it is necessary to use 15 to 24 cwts. per acre of these mixed manures in order to apply the equivalent of 2 cwts per acre of muriate of potash.

DRAINAGE

Although this aspect will not be discussed at length nevertheless adequate drainage is an important factor in growing successful crops in swamps. Swamps are normally drained, but where waterlogged patches occur, the drains are usually not deep enough or placed too far...
apart. In practice these waterlogged patches can suffer from soil salinity due to summer evaporation, or the restricted root growth may induce drought or reduce the uptake of plant nutrients.

REFERENCES


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