HYDROPONICS Plants without Soil

Carmel Galea

In the early 1930s an American Professor, Dr. William Gericke, of the University of California attempted to transform laboratory-style soilless cultivation into practical terms. Taking advantage of the sunny Californian climate, he set out-of-door growing units. He had considerable success and he proceeded to name the new garden science hydroponics. With the publication of the results of these tests, the use of hydroponics spread across most parts of the world.

Hydroponics is generally defined as the science of growing plants without using soil feeding them instead on solutions of water and mineral salts, rather than relying upon the traditional methods. However, hydroponics has been employed in numerous ways and in different forms. An immense amount of scientific research has been undertaken to develop really simple and practical ways of growing plants without soil.

A particular form of hydroponics is that of recirculating water-culture, first used in the USA by research workers. This method of growing plants in containers, through which nutrient solution is recirculated, gave excellent plant growth, but has, nevertheless, merely remained a research tool.

Work on this method was taken up seriously in 1965 by researchers in Great Britain and in 1973 the first account of the results was published in the May issue of *The Grower.* The method was named 'nutrient-film technique' (NFT) because it differed from the method used in the U.S.A. in one small, but vital, detail. The plants are grown in a recirculating *film* of nutrient solution; hence the name *nutrient-film.* Although research is still going on, already several growers are using NFT on a commercial basis.

A simple NFT system may be set quite easily by any home gardener on the following lines. An NFT system is not difficult to set up at home. I have set up one myself and it has now been going for over a year with considerable success and great personal satisfaction. However, one must be prepared for some ups and downs, particularly during the first trial period but this should not dishearten the beginner. The ground should be smoothed down to a slope of 1 in 25. It is of utmost importance that the ground should be as smooth as possible to eliminate all local depressions.

Narrow water-tight gullies are laid on the ground. These gullies are made of black polythene. It is desirable to have the polhthene as thick as possible because otherwise tension would be created and this makes an even distribution of the solution impossible. Polythene of 100 gauge is ideal for the gullies. However, if this is not available the 500 guage is also suitable. Plants are placed in the gullies and the edges of the polythene are clipped together with clothes pegs.

The plants may be placed in any rootng media. However, it is advisable to use 3½" bituminised-paper pots filled with peat and sand. These pots are inexpensive and are easily obtained from most garden shops. When these pots are stood in a gully the roots quickly emerge from the pots and the main root system develops as a continuous mat in the stream of solution flowing down the gully. Plastic pots should not be used, as in these the roots tend to remain within the pot and growth suffers.

A catchment tank is placed at the lower end of the ground. This is filled with the nutrient solution which is pumped through a plastic pipe to the top of the ground. A small pump can be used efficiently for this purpose. The solution is discharged from this flow-pipe into the gullies through small holes 4 mm in diameter, drilled in the pipe. The solution flows down the gullies, by gravity, as a film less than 1mm deep. After passing through the gullies the solution is discharged back into the catchment tank.

It is important not to allow a depth of liquid to build up in the gullies, hence the necessity to smooth the slope to minimise the effect of localised depressions. If only a film of liquid flows down the gullies a thick root mat develops above the film of flowing liquid. This ensures that all the roots remain moist while the upper surface of the root mat is exposed to the air. Thus, no matter how long the gully is, there is no shortage of the oxygen supply to the roots even at the end of the row.

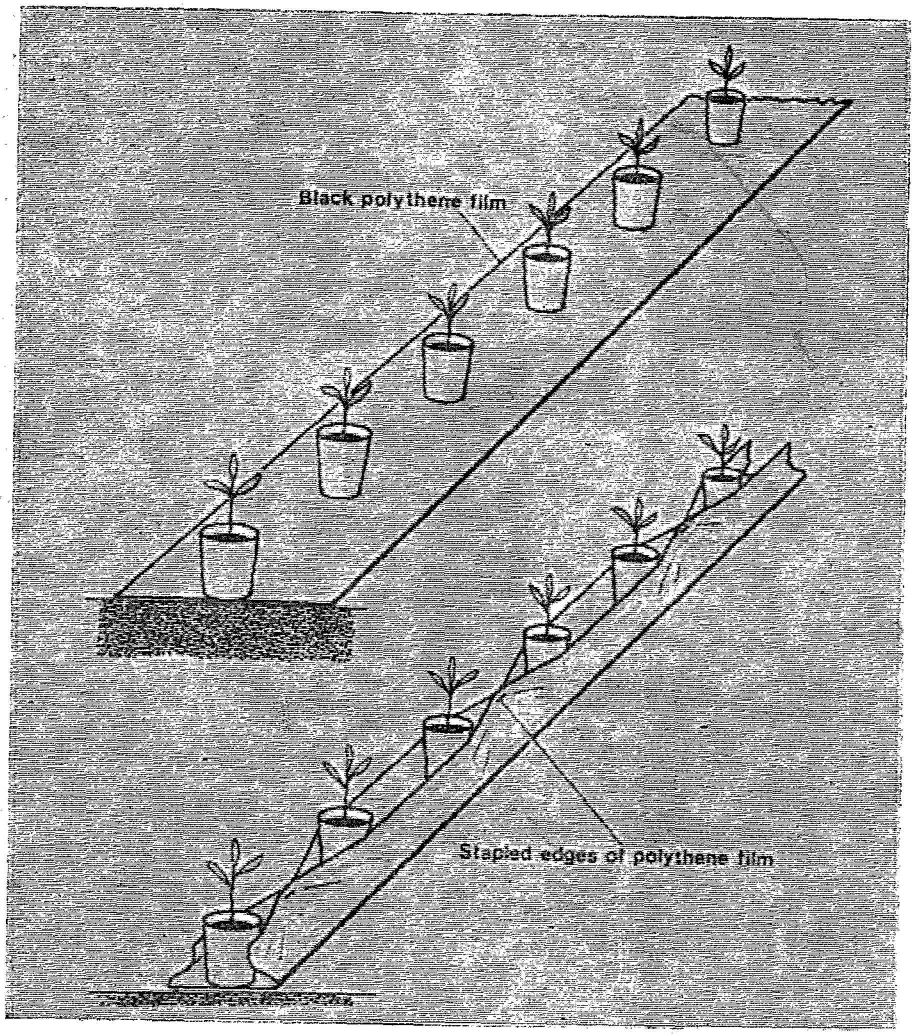
It has been established that there is a much greater tolerance in nutrient supply when liquid flows past the roots. Because of this tolerance the nutrient supply can be easily monitored. In fact, analysis of the individual salts has not been found necessary. All that is needed is a measurement of the electrical conductivity by a conductivity meter. When the conductivity reading falls below a given value of 20, a topping-up solution is added to the catchment tank. It is suggested that the conductivity factor of the solution should be maintained between 20 and 30.

Occasional checks on the pH should also be made. As the nutrients are removed by the plants the pH will rise. When the pH rises above 7.0, phosphoric acid should be added to the catchment tank. The pH of the solution should be maintained between 6.0 and 7.0

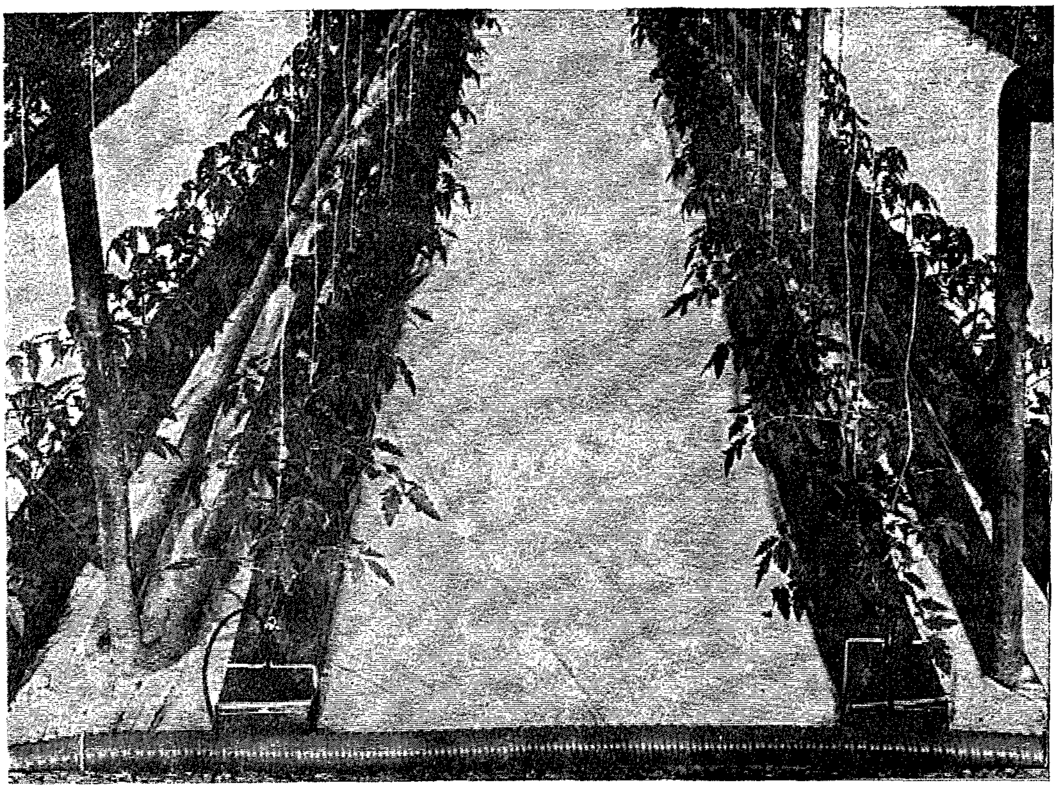
A suitable nutrient mix should contain Calcium Nitrate, Potassium Nitrate, Magnesium Sulphate, Potassium Sulphate, Chelated Iron, Manganous Sulphate, Boric Acid, Copper Sulphate, Ammonium Molybdate and Zinc Sulphate. On a day with high solar radiation integral the water uptake by the plants is large. The salt concentration in the solution is thereby increased and a hardening of the growth may take place. It is, therefore, desirable to have a mains water top-up by a float-valve in the catchment tank. This top-up can also be made manually everyday, sometimes even twice a day.

Research work on various aspects of NFT cropping is still going on. However, the most important results have been published and many commercial systems have already been set up. Commercial growers have realised the potential of NFT and the advantages it possesses over conventional systems. These advantages include (i) the elimination of the conventional drying cycle between waterings and the rapid checking that all plants are receiving enough water, (ii) rapid 'planting' (iii) the precise control of nutrient and a large saving in fertilisers, (iv) the elimination of soil sterilisation — soil-borne disease is, of course, completely eliminated, (v) the maintenance of optimal root temperatures by warming the nutrient solution — eliminating the need to heat the air inside a glass-house.

In addtion one should mention the overriding benefit of increased yields, compared with conventional cropping. Examples of the success of NFT cropping are provided by the 10 crops a



Preparation of the gully



Tomato plants in nutrient film gullies

year of good quality lettuce that are being obtained in the open in Queensland, the seven crops a year of cordon cucumbers yielding 400 tons/acre in California and 130 tons/acre of tomatoes that have been obtained from a single November sowing in England.

Carmel Galea B.Sc., M.Sc., teaches Mathematics at the Upper Secondary School, Valetta.