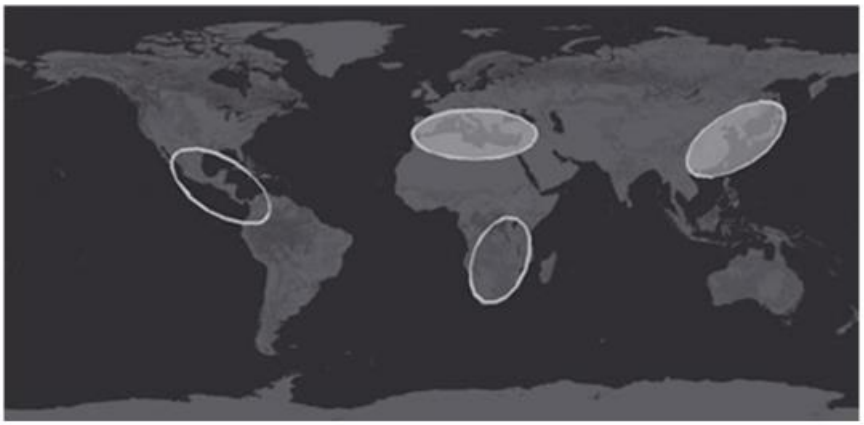
Short training course on long-term experiment for agricultural product quality

The courses are conducted in Shouguang and Taian city, Shandong province, by technical visit, official meeting and free talk.

1. Long time experiment for vegetable quality safety in Shouguang.

Shouguang (Chinese: 寿光) is a county-level city located in Weifang Prefecture-level city, Shandong Province, China. The local government is currently focused on developing the city's service, industry and technology sectors as well as maintaining Shouguang's reputation as China's "Home of Vegetables" (蔬菜之乡 pinyin: shucai zhixiang).

Prof. Pedro gave a presentation on vegetable production in the world. Shouguang and Almeria are the two major and most intensive greenhouse vegetable production areas, both of which has the history for using fertilizer and pesticide. Both need to solve this problem as soon as possible to make their production sustainable.



Greenhouses distribution worldwide

Distribución geográfica de los invernaderos en el mundo. (Cotec, 2009)

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2. **Long time experiment for fruit quality safety in Taian**

The apple is among the four most popular fruits in the world, and as an essential fruit for human health, high fruit quality is important. Apple trees are perennial crops that have a production life of several 10s of years, requiring high levels of grower expertise and cultural management. In the Internet era, where information plays a key role in our life, fruit cultivation is rapidly becoming a very data intensive industry. For example, farmers make decisions based on huge volumes of information obtained from a diverse number of devices, such as meteorological sensors, farming machinery, and short messages, to enhance production and to ensure fruit quantity and quality for maximum economic gain. As a result, farmers require modelbased decision support systems to provide information services. Modeling systems were first used to enhance crop production in the mid-1970s, using mainframe computers. Decision support systems in agriculture first appeared in the late 1980s and early 1990s, when desktop computers became more readily available and affordable; however, their application was limited to the time required to input data and retrieve useful information from the computers. Fortunately, with the maturation of mobile technology, such as cellular phones and Personal Digital Assistants (PDAs), and the widespread adoption of the Internet, farmers are now able to collect agricultural production data and obtain decision-support by wireless devices wherever and whenever they want. Digital agriculture, or the Internet of Things (IOT) in agriculture, has become increasingly popular; however, existing and future systems tend to operate under specific models that have a theoretical basis and scientific support. In addition, model implementation is dependent on the decision

support system being used. Much work has been devoted to modeling the growth and development of fruit trees in relation to orchard management and decision-making processes. In these models, trees react to their environment and management interventions by adjusting their physiological functions and structure.
Prof. Nick Sigrimis has given a training course about fertigation in fruit trees related to product quality safety.

In supplying plants' nutritional needs complete methods to service these needs of the plants were/are to estimate:
a) the supply capacity of soil material for several minerals (for which occasionally we need a soil analysis), b) the water contained minerals (sometimes useful Ca and Mg as well as other trace elements), for which we also an analysis and if seasonal changes we should follow, and c) the additional amounts of macro and micro elements we need to supply
Traditionally, when modern way of supply by water (micro_sprinkler, trickle and dripper irrigation) was not possible, we considered the soil as the storage tank for occasional supply of fertilizer by hand or machine. However this method has had the following drawbacks:
1) The supply did not fit normally the rational needs of plant uptake, as per crop stage different growing organs (spring leaves, blossom flowers, fruits, xylem), despite the fact that different fertilization synthesis was tried at different stages. This is the role of "complex fertilizers" that companies make to fit approximately the needs of different plants at different stages but again occasional supply. Therefore Plants (Trees) do not

deliver their maximum utilization of Solar Radiation conversion to quantity and quality, obeying to the law of “minimum element”.

2) The occasional storage of a periodic volume of fertilizer is causing big losses due to: a. Conversion: chemical conversions and adherence to soil compounds as sediment complexes or non-soluble substances (which the roots we expect to have the power to re-dissolve and uptake but this is not for high production plants but rather for stressed-struggling plants or wild plants or weeds). This process, we may assert, is not only fertilizer loss but also soil alteration to imbalanced nutrition or soil degradation, and b. Depletion: a heavy rain event usually takes most soluble elements (K, N, some micros) away and it’s another big loss but also environmental pollution of surface (eutrofism) and underground waters. Such loss also occurs because of high irrigation dose that is most often applied by the “non-informed” farmer to “secure his plants”, lack of measurements or bad water application method (surface furrowing, border flooding etc).

Usually after fertilization research trials we have come up with certain “needs per stage” which are converted to fertilizer synthesis (recipe) to be supplied with the irrigation water, or, the “expert” has concluded to a specific recipe at each stage of development. Well estimated (model) or measured (sensor, soil or plant) water needs and precisely and purposely calculated nutrient supply can be supported by high tech Fertigators. This cannot be alone but together with precision application water system (drippers) to alleviate the above mentioned losses, caused by traditional fertilization techniques. Many researchers are involved today into Precision Fert-Irrigation programs. We develop methods and Web Services to exercise all possible physical measurements and Plant Science knowledge about plant nutritional responses. It is a sustainability effort (ICM) targeting the best product quality and yield, while protecting the environment and the resources.

A physico-cyber model to simulate the plant life processes and derive the physical needs of the plant is as the following: *: based on specific element boosting some product properties for specific effects or pest resistance.


大量元素水溶性肥
Water soluble fertilizer
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