

Chemistry in Agriculture



Chemistry is recognized as the central science for the simple reason that all the other science subject we learn (Biology, Physics, Geology etc.) do need a basic knowledge of Chemistry. In studying Chemistry, we study about composition and properties of matter and the changes that the matter undergoes.

Agriculture on the other hand includes production and processing of agricultural commodities (mostly edible matter) and their distribution to the final users. Based on the varying development in different parts of the world, agricultural needs and the production mechanisms have drastically changed. As these changes are accompanied with a time factor the involvement of Chemistry in Agriculture becomes more and more important.

Agriculture can be considered as a mode of combating hunger or a mode of generating income. Farmer earns by selling his produce, and the government earns by exporting agricultural commodities, in both cases raw or processed. By definition "Agriculture" is the science or practise of farming, including preparation of the soil for growing crops, and rearing of animals to provide food, wool and other products. Therefore Agriculture as a study discipline, is divided into several sub sections. Of these sub sections the sections that have a direct relationship to Chemistry are, Soil Science that deals with soil properties and preparation



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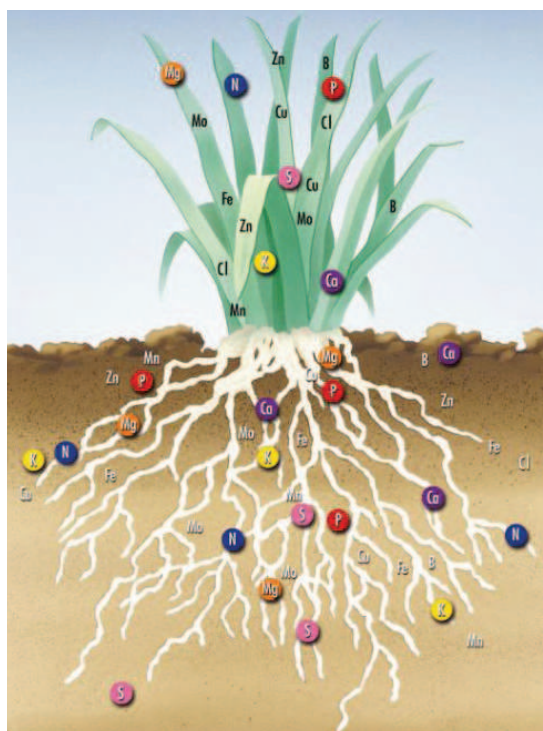
of soil for farming; Crop Science that deals with cultivation, maintenance and harvest of agricultural commodities; Agriculture Engineering that deals with management of water resources and development of farm machinery; Agriculture Biology that deals with the growth pattern of plants, insects and other invaders to the crop and genetic manipulations; Animal Science that deals with rearing and maintenance of animals

and carrying out animal product processing; Food Science and Technology that deals with preparation of raw agricultural products for consumption and value addition to the food commodities. Other than these sub sections directly involved in agro product processing, two other educational sections in Agricultural economics and Agricultural extension are there for the farmers to get educated and to get a better return from their investments.

Chemistry and Soil Science

Soil is the best medium for a plant to grow. Soil Science deals with all aspects of soil; chemical, physical and biological, all of which are important for plant growth. Chemistry finds application in Soil Science mostly in estimating the chemical properties of soil which determines the plant growth. Plant nutrients, especially minerals, their available forms and the carbon content in soil need to be studied before deciding on the crop, as these are important in plant growth. Equilibrium principles in Chemistry are used in extracting available soil nutrients. Ion exchange principles are used in

calculating the base exchange capacity of soils. Based on the chemical analysis results farmers are advised to use fertilizers in relevant proportions. If you consider fertilizers, they are synthesized by chemical means and mixed in required proportions to suit different types of soils. Soil pH measurement is also carried out frequently to get an idea about the salinity levels of the soil which is affecting plant growth. During the post tsunami operations in Sri Lanka, soil scientists played a major role in determining the salinity levels of the paddy fields in low lands due to intrusion of salt water. Therefore one could conclude that the management of a fertile soil suitable for agriculture needs the support of a soil scientist competent in analytical chemistry.



need to be studied prior to its application. Solubility, volatility and toxicity of the substance should also be known. Once the agricultural produce is harvested the post harvest handling of the crop needs great care to minimize losses. Chemical reactions related to the science of ripening should be well studied and the precautionary measures need to be adhered to avoid post-harvest losses of the agricultural produce. Pheromone baits are often used to trap the insects in bulk. These chemical compounds are synthesized based on the information collected on the natural compound isolated

from the insect itself. This leads to the laboratory synthesis of such active compounds in bulk to be used in insect control in large scale agricultural farms.

Chemistry and Crop Science

Crop Science recalls our memory of a farm practise, where the farmers prepare land, plant and maintain until it is harvested. Therefore the Crop Scientist needs to have a thorough grasp of all aspects related to the mode of providing nutrients and water to plants, protect the plants from weeds and invasive species of plants, and also the agricultural produce from insects etc. To achieve this task good chemistry knowledge is important to match the plant nutritional requirement. All analytical chemistry experiments need to be performed in order to get a good analytical report about soil characteristics. Use of agrochemicals as a control mechanism needs to be carried out with great care. One must select the correct chemical to suit the requirement, for which the person needs to know simple chemical formulae of the substance of interest. The person applying the agrochemical should be educated on the hazards associated with the substance, which means all physical and chemical characteristics

Chemistry and Agricultural Engineering

Agriculture engineering today deals mostly with waste management, water resource management and pollution control in all of which knowledge of Chemistry finds many applications. During waste management the scientist should make sure that no hazardous by-products are being released to the atmosphere or to water bodies. Therefore the scientist needs to be aware of the possible chemical reactions that would take place during waste management based on the type of waste that the person is handling. Only with a thorough grasp of Chemistry and related sciences environmentally friendly mechanisms can be applied for waste treatment as well as for soil/water/air pollution control measures. When it comes to food process engineering, process control parameters should be set considering the material that is processed, and also the product expected. In product processing, the Department of Agricultural Engineering needs to work in collaboration with the Department of Food

Science and Technology and the Department of Agriculture Biology.

Chemistry and Animal Science

Animal Science is a major contributor to Agriculture, especially as a provider of raw material for meat product processing industry. In Animal science animals need to be grown up, taken care, and slaughtered at the correct interval for product processing. All these situations need a thorough understanding about chemistry and related sciences. The feed formulation totally depends on the chemical composition and the physical properties of the feed ingredients. Therefore nutritional analysis of the raw material is important in deciding the ratio of mixing for feed formulation. Once formulated the predicted nutrition composition should be checked back using a chemical analysis. Veterinary medicines such as antibiotics and growth hormones are given to farm animals to keep them healthy and also to get them grown to a marketable size in a short period of time. Even though this is achieved through a knowledge of chemistry, there is a tendency to have residual chemicals in the animal product creating problems to the customer. The scientists therefore need to look at their recommended application patterns, tolerable concentration and toxic levels to decide on a feed supplement or a hormone. Aquaculture is also becoming more and more popular among the general public. Here again the residual antibiotics have caused much concern with the consumer. It is better for the farmers to have some knowledge about the chemical and biological demand of the water body (COD and BOD) that they wish to use for aquaculture. During preparation of meat products (E.g. sausages) sodium nitrite and nitrate are added as a preservative. If the user has no idea about the action of these chemicals, their permitted levels and expected hazards, the producer may use it in high concentration creating problems at the consumers' end.

Chemistry and Food Science

Food Science is the subject area in Agriculture which is very much closer to Chemistry. Food production in the world has become less challenging, due to the

support of the Chemistry knowledge and the available range of chemicals supporting growth of agricultural commodities. With the help of fertilizer application soils can be made fertile and thereby the agricultural land for food production can be increased. But one should study mechanisms of the degradation of these agrochemicals and related risk factors associated before application. A team comprising of a chemist, soil scientist, biologist, crop scientist and a food scientist can discuss and come to an agreement as to how and when the agrochemicals should be used. Food Scientist is worried about the residual agro-chemicals which are going to harm the consumer's health. Also during food processing certain toxic chemicals (acryl amide, poly aromatic hydrocarbon etc,) are generated and the person should be aware of such chemical reactions and then decide on processing conditions such as temperature and heating time. When it comes to ripening of fruits, use of artificial ripening agents have become popular among the producers/consumers. The user need to have a clear idea about the application, decomposition of the material and the hazards associated with residual chemicals before deciding on a ripening agent. Food processing and development of new food products based on the consumer need had been the practice throughout. Present day consumer is more interested about health and therefore the antioxidants in food product attract the consumers. The processing parameters should be determined after a thorough analysis of the chemical changes that can take place in the food product to create safe foods for the consumer.

You may now realize that Chemistry is there everywhere as far as agriculture is concerned. Agriculture is the mode of food production in which chemistry finds application in all events starting from selecting a land for cultivation down to production of a canned food product available in the super market.

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