SECTION 1: CLASSIFICATION OF BOTANY AND USE OF PLANTS

1. Introduction

Botany refers to the scientific study of the plant kingdom. As a branch of biology, it mainly accounts for the science of plants or ‘phytobiology’. The main objective of the this section is for participants, having completed their training, to be able to:

1. Identify and classify various types of herbs
2. Choose the appropriate categories and types of herbs for breeding and planting

2. Botany

2.1 Branches – Objectives – Usability

Botany covers a wide range of scientific sub-disciplines that study the growth, reproduction, metabolism, morphogenesis, diseases, and evolution of plants. Subsequently, many subordinate fields are to appear, such as:

- Systematic Botany: its main purpose the classification of plants
- Plant morphology or phytomorphology, which can be further divided into the distinctive branches of Plant cytology, Plant histology, and Plant and Crop organography
- Botanical physiology, which examines the functions of the various organs of plants

A more modern but equally significant field is Phytogeography, which associates with many complex objects of research and study. Similarly, other branches of applied botany have made their appearance, some of which are Phytopathology, Phytopharmacognosy, Forest Botany, and Agronomy Botany, among others.

Like all other life forms in biology, plant life can be studied at different levels, from the molecular, to the genetic and biochemical, through to the study of cellular organelles, cells, tissues, organs, individual plants, populations and communities of plants. At each of these levels a botanist can deal with the classification (taxonomy), structure (anatomy), or function (physiology) of plant life.

Historically, botanists have studied all organisms that were not generally recognised as members of the animal kingdom. Some of the ‘plant-like’ organisms include algae (studied in phycology), fungi (studied in mycology), bacteria and viruses (studied in microbiology). Most algae, fungi and microbes, are no long considered to be part of the plant kingdom. However, attention is still given to them by botanists, and most usually, bacteria, fungi and algae are covered at some point during introductory botany courses.

So why the need to study plants; Plants are a fundamental part of life on Earth. They produce oxygen, food, raw materials, fuel, and medicine, all allowing higher life forms to exist. Furthermore, plants consume and extinguish carbon dioxide from the atmosphere - a form of gas that significantly contributes to the greenhouse effect - using it during the process of photosynthesis. (However, not only plants perform this process, and also, there are some non-photosynthetic plants.)

A thorough and proper understanding of plants is essential for the future of mankind. It can contribute to:

- Food creation
- The understanding of the fundamental processes of life
- The production of useful materials
- The preparation of medicines
- The understanding of environmental changes

Virtually all of the food people consume comes directly from plants, primarily through the production of staple foods, such as fruit and vegetables, or through livestock, which is directly associated with plants. In other words, plants are to be found at the base of nearly all food chains. Understanding how crucial plants are for the production of the food people consume is of great importance, in order to be able to provide food and food security to future generations. A most profound example would be the breeding of plants and the continuous improvement of their properties. Of course, not all plants are useful to humans. Weeds have always been a very significant problem for agriculture, and Botany is the basic science for realizing and understanding the possibilities of minimizing their action. This refers to Ethnobotany, the scientific study of the relationship that exists between humans and plants.

Many medicinal and recreational drugs such as cannabis, caffeine, and nicotine, derive directly from the plant kingdom. Another example is aspirin, which was created from the bark of willow trees. This shows that there may be many novel cures for diseases provided by plants, which are yet to be discovered. Many popular stimulants such as coffee, chocolate, tobacco, and tea are also the outcome of plant exploitation.

Plants are also responsible for providing many natural materials, such as cotton, wood (secondary), paper, linen, oils, as well as some types of rope and rubber. These are just a few examples of material that people use in their every-day life. The production of silk would not be possible without the cultivation of the mulberry plant. Cane plants, as well as other plants, have recently been used as sources for biofuels, which are significant alternatives to fossil fuels.

These are only some very few examples that very clearly illustrate how the plant kingdom is essential in providing a variety of raw material and medicines to mankind.

3. Systematic Taxonomy

Systematic taxonomy refers to both theoretical and practical aspects used by biologists to classify living beings. Its usability lies behind the need of separating the huge variety of living organisms found all over the natural world: from massive-sized whales to the tiniest of bacteria. This application of classification provides an internationally acknowledged and usable nomenclature. Generally, it is part of the broader science of Systematic.

Aristotle was the first one to gather all the relevant knowledge of his time, and was able to further enriched that with his own observations, by gathering everything together into scientific groups. After 2,000 years, the Swedish botanist Carolus Linnaeus (1707-1778) managed to systematically classify all three individual nature systems; Plants (Regnum vegetabile), Animals (Regnum animale) and Minerals (Regnum lapideum). The criteria for the classification of organisms are morphological. The main composed groups are subdivided into further smaller groups, those to even less small etc.

Living organisms that exist in the natural world exhibit a surprising variety, from tiny single-cell bacteria, to medium-sized plants and animals, to the massive sizes of an elephant or a whale.

This variation has derived from the changes that have occurred in these organisms over millions of years, and we can easily observe this all around us, when placed in a natural environment. Biologists use a classification system for organisms, a way of separating them into groups according to their morphological, physiological and reproductive characteristics. This classification is what helps to better study those organisms and their evolution.

The largest taxonomic groups are the five kingdoms:

- Solitary (unicellular - prokaryotic organisms: bacteria and blue-green algae)
- Primarily (unicellular - eukaryotes: protozoa and algae)
- Fungi (eukaryotes with great variety: molds or mushrooms)
- Plants
- Animals

When an organism is classified, a two word scientific name in Latin is given to it, in order to be properly classified into a taxonomic group. The first word indicates the gender of this organism, while the second denotes its kind (by C. Linnaeus).

The main taxonomic groups are :

- Kind
- Gender
- Family
- Phylum
- Class
- Infraclass
- Kingdom

As we move from a single species to the entire kingdom, the range of the taxonomic group increases, with the addition of a growing number of organisms, while the similarities between them are being reduced. Therefore, there are more similarities and fewer differences between organisms of the same species, in contrast to those of a class or the whole kingdom. The following examples will help to clarify certain things:

TAXONOMIC GROUPS	Pine	Wildcat	Human
Kingdom	Plantae	Animalia	Animalia
Phylum	Tracheophyta	Chordata	Chordata
Class	Gymnospermae	Mammalia	Mammalia
Infraclass	Coniferales	Carnivora	Primates
Family	Pinaceae	Felidae	Hominidae
Gender	Pinus	Felix	Homo
Species	halepensis	silvestris	sapiens

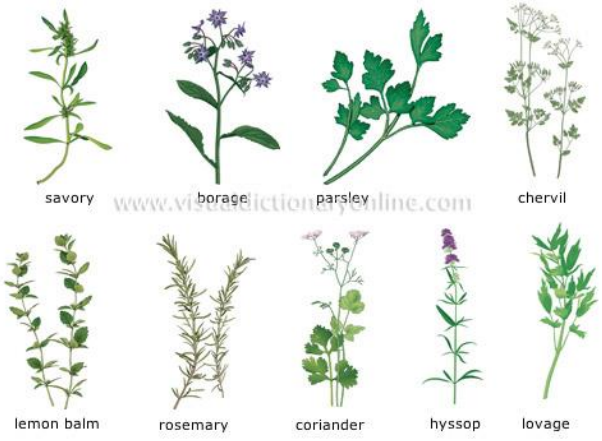
Today, the newer classification systems are not as technical or physical as those of Linnaean, since the external resemblance or similarity of the internal construction is no longer considered as the basis. The systematic classification is now based on phylogenetic classification since it aims at finding the kinship and common origin of species. The comparison of genetic material (DNA) of organisms has greatly contributed to this task.

The scientific names in Zoology and Botany are eminently of Greek and Latin origin. Words of Greek origin appear in Latinised forms, attributed to Latin characters and according to matching sounds. Of the two names of the scientific title, the first is a noun and designates the gender, while the second is an adjective and defines its kind.

4. Herbs

4.1 Definition - Data

«Any plant with leaves, seeds, or flowers used for flavouring, food, medicine, or perfume:…». This is the exact definition of ‘Herbs’ according to the Oxford English Dictionary. This definition includes a wide variety of plants with multiple uses, such as food, healing, perfumery, cosmetic or otherwise. Only over the last 2-3 centuries the term 'herb' was eventually narrowed down to referring to the therapeutic uses of some plants. All ancient cultures have their own herbal medicine. The oldest written records date back to the Egyptian Papyrus Ebers, around 1700 BC, although we know that in Egypt there were formal schools of herbology from 3,000 BC. In China, one of the most famous treats on herbal medicine, which is still used to date, was written by the former Emperor Shen Nong, around 2,700 BC. Hippocrates supported many of his treatments on those, while two great Greek botanists, Dioscorides and Galen, influenced the teaching



methodology of medicine for hundreds of years in Europe, through their books.

Dioscorides' botanology, De Materia Medica, formed the basis of a famous botanology composed by the German Deodens, as well as that written by the Englishman John Gerard, the botanist and herbalist of King James. There must be a reason though as to why herbs are back in the spotlight after so many years, especially now when both Medicine and Pharmacy, are in the pinnacle of their glory; We need to identify their role in present day times behind the shadows of this immense technological expansion. After all, they do have their own legacy of great importance. We need to find out why more and more people are returning back to these 'primitive' methods of treatment.

So why herbs, when we know that the active ingredients in many of the medicines we use today come from plants? Glycoside, digoxin, and digitoxin, are all substances used for heart diseases and come from a ring plant. Morphine, which is used as an analgesic, comes from the poppy flower. Salicin, a precursor of acetylsalicylic acid, which is the active substance of aspirin, comes from the bark of wicker. Many other active drug substances can today be prepared synthetically in laboratories.

The answer to these questions may perhaps be found in the following example: the Indian ‘snakeroot’ (Raufolfia serpentina) has been used for centuries in Ayurvedic Medicine to cure several diseases, such as snakebite, headache, anxiety, hysteria, fever and bellyache. It has been said that even Mahatma Gandhi had been using the snakeroot tea whenever he was feeling tensed. In 1947, the pharmaceutical company CIBA extracted alkaloid reserpine from the snakeroot and placed it in the market in its pure form under the name of Serpazil, for the treatment of hypertension.

In its pure form though, reserpine was proven to carry some negative side effects on the health of patients, who were likely to experience severe manic depression and abnormal slowing of the heart rate. The drug was then withdrawn from the market, but drinking tea extracted from the whole plant of the snakeroot continues to be used as a famous folk nostrum.

Modern medicine rather ignores the fact that plant and animal organisms have evolved for centuries in parallel ways. Consequently, there seems to be some partial adaptation of animal species to the biochemistry of plants, in contrast to the highly reactive current of present day. Therefore, some superficially less important plant components exhibit synergistic action, through which they can convert some plant components from inert to reactive, making their availability easier to the human

body. Some other plant components neutralize the action of hazardous chemicals, preventing any possible harmful effects of the use of this plant.

In everyday life, particularly inner city population, the role of plants is taken very lightly. People consume corn flakes in a form that has no resemblance to actual corn, bread that does not reflect to real wheat, or even wear clothes which point nowhere near actual cotton. Everyone has lost that old sense and relationship with nature and plants, where a single herb could make the difference between survival and starvation or life and death.

Plants are now mostly used for decorative purposes or perceive them as luxury goods, from houseplants to exotic fruits we sometimes share on our table. The actual extent of the dependence on plants now escapes people, with modern lifestyle more closely related to ‘products supplied from supermarkets. The use of herbs in simple and practical ways can only mean that we gradually begin to appreciate their value, the mystery of their composition, the delicacy of the natural oils that are so easily adapted to the treatment of our body; All the amazing properties that this huge variety has to offer to us.

Therapeutic botanology is mainly based on the use of whole non-distilled or extracted herbs, advocating that the active ingredients are safer when not isolated from other natural organic

substances, and moreover on the individual prescription for the restoration of dietary or biochemical disturbances in particular patients. For these reasons, more time is required to afford specific results.

4.2 Herb Varieties - Uses

The black lovage (Smyrnium olusatrum, Apiaceae family) is similar to lovage and celery, and has aromatic roots, leaves and fruit. Today, the culinary significance (importance) of this herb is low.

Mastic is a resin obtained from the plant Pistacia lentiscus var. chia (Anacardiaceae family), a tree that can only be found growing in the island of Chios, in eastern Greece, although the gathering of lesser quality product from other trees of the same family occurs. It was considered as an important species during the Middle Ages (12th-15th century), but now it is mainly used in Greek cuisine.

The vlichouni or pennyroyal, (Mentha pulegium) (Lamiaceae family), differs quite significantly from culinary mint. It has been used since ancient times in Roman cuisine. Despite its mild toxicity, it is considered as a traditional herb in Britain.

Lesser Calamint, Calamintha nepeta, is an aromatic herb used in regional Italian cuisine (nepitella). Its distinct aroma can account for its relationship with herbs of the Labiatae family, such as thyme, mint or oregano.

The pine nut seeds (pignoli) are the seeds collected from the Mediterranean pine (Pinus pinea, Pinaceae / Pinales family). In specific places around Asia pine related species can also be found. They have a wonderfully aromatic flavour, which is essential in Spanish and Italian cuisine, for example in pesto.

Purslane (Portulaca oleracea, Portulacaceae / Caryophyllales family) is a seasonal herb that possibly originates from the Himalayas, but today it has naturalized in western Asia and southern Europe. Although often consumed when cooked as a vegetable, its raw leaves and stalks have a crunchy texture and salty fresh taste, which makes it a great garnish for cold Mediterranean dishes,

including West Asian appetizers. The flower buds are more tasty and can be used as a replacement for caper.

Samphire (Crithmum maritimum, Apiaceae family) can be found across the vast majority of European coasts, from the Atlantic Ocean to the Black Sea. The leaves are juicy with a savoury and aromatic flavour. It was formerly a most popular flavouring for salads and pickles, and was better known in Britain. Today, it is still quite renowned in the Mediterranean.

Bermuda grass (Cynodon dactylon) is one of the most useful medicinal plants and is included in many combinations for the treatment of prostate cancer. A natural antibiotic and one of the most famous diuretics. It can be used as a softener without any side effects, while also cleanses the body from toxins and reduces blood cholesterol. It helps against liver colic, gallstones, and cellulite. It acts as an antiseptic and anti-inflammatory in urinary infections such as cystitis, urethritis, prostatitis, rheumatism and arthritis, as wells as skin diseases and hepatitis. It is beneficial for kidney stones and gravel (sand in the kidneys).

It's good for bladder infections, jaundice, hepatitis, arthritis, kidney stones. It cleanses the blood.

Agrimonia Eupatoria is used by botanic therapists today, mainly as a stimulant of the digestive system, and is a plant that heals wounds and illnesses. Considered particularly effective for ulcers, colic and diarrhea. The tannins it contains in combination with with some other active substances, can produce diuretic, astringent and anti-inflammatory properties. This herb is used in folk therapy for the healing of open wounds, insect bites, snake bites and the dissolution of abscesses.

Yarrow (Achillea millefolium) blossoms in Spring time, and is a great tonic for people who show signs of tiredness, It can be used for disorders during menopause and spasms of the matrix, colds, to purify the blood, helps acne, asthma, colitis, arthritis, period pains and rheumatism. Relieves abnormalities in the bloodstream, so it is used in varicose veins and phlebitis. It's good for oily skin and cleanses in depth, it heals many skin problems such as acne and herpes, helps with skin inflammations, monks, allergies, itching and lichen. Because it cleanses the blood, is used internally as an infusion into skin. It helps to cure stretch marks on the nipple, as well as fissures in hands. It can also help with the cure of haemorrhoids and relieves the pain. It can also prevent hair loss, if

frequent rubbing with a decoction of Yarrow occurs. It has pain-killing properties, and when chewed, the fresh leaves of the Yarrow can stop the toothache.

Wormwood (Artemisia Absinthium) is a digestive stimulant, an extremely useful drug for those who exhibit poor digestion. It increases the acidity of the stomach and improves digestion and the absorption of nutrients, thus aiding against other diseases. Generally, when consumed in moderate doses, the ingredients of the plant stimulate the stomach, increase the appetite, facilitate digestion, accelerate the circulation of the blood, cause secretions, contribute to slimming and aids to the digestion of fats. In therapy, the seeds of the plant are used. It has a beneficial effect in people with diabetes and helps fight rheumatism. It can be used to fight anemia, as an antipyretic, and has diuretic properties. Externally, it can be used as an antiseptic.

It can help eliminate epilepsy, dizziness and fainting, and also, to stops diarrhea and vomiting. It can also help with liver failure.

Basil (Ocimum basilicum) can drive away nervous headaches. It can create better appetite. Also, it helps with poor memory, depression, anxiety, dizziness, intestinal disorders and abdominal bloating. It can aid digestion and reduce bellyache, dizziness, nausea and common cold.

Valerian (Valeriana officinalis) is a sedative, hypnotic and anxiolytic plant. Eliminates insomnia, nerves, anxiety, migraines, neurasthenia, headache, and heartburn. More extensively, it is very helpful in eliminating insomnia and further improves the sleep quality. It has anxiolytic and sedative properties which can alleviate stress, nervous asthma, epilepsy and tachycardia. It is very useful in cases of arthritis, hypertension, colic, rheumatic pain, migraine, toothache and dysmenorrhea. Attention though! Larger doses can cause malaise. Contradictory use for women during pregnancy and lactation as well as people suffering from mild depression.

Vihio: Suitable for cold and smoking

Daphne: For foods. The powder of dried leaves stops a bleeding nose. It strengthens the hair and can be used for cosmetic purposes, for dyed black hair. Also, it can prevent hair loss. Relieves pain from arthritis and rheumatism.

Rosemary: Can be used for colitis, diarrhea, bronchitis, asthma and flu, intestinal disorders, rheumatism. It stimulates the appetite.

Spearmint: Can be used as a garnish or to give taste in food. It helps with lowering cholesterol, insomnia, cramps, dry cough, tonsillitis, tooth pains, rheumatism. Recommended in cases of indigestion and diarrhea, can also bring ease to the stomach after vomiting.

Dittany: Soothes stomach aches and intestinal pains. It can help with headaches, toothaches and scurvy. It is a diuretic, helps women give birth more easily and quickly.

Eucalyptus: Very useful for patients with diabetes since it has a hypoglycemic action. Lowers fever. Soothes coughs, asthma, flu, bronchitis, neuralgia and sore throats. Suitable for inhalation in situations of sinusitis and bronchitis. When eucalyptus is boiled, the vapors ionize the atmosphere of the room and make more comforting.

Sampucus: Used for neuralgia. For cystitis, tonsillitis, ponomato, toothache, sore throat. It cleanses the blood.

Thyme (Thymus vulgaris): It can be useful against stress, circulation, depression, migraines, nerves. Necessary for patients with hypotension, for flu, colds, coughs and asthma. Good for skin diseases, leucorrhoea, healing wounds, boils and burns.

Savory (Satureja hortensis): For the stomach, nausea, sourness, or even as an appetizer. Helps with insomnia, arthritis, rheumatism, asthma, cough. Stops colic and diarrhea. Useful with mental and sexual debility.

Hibiscus: For cholesterol, triglycerides, circulatory, sugar-diabetes, weight loss, headache.

Cardamom (Lipidium sativum): Contains vitamins, iodine, iron, calcium, cordial, cleans the blood and removes freckles and blemishes.

Calendula: Strengthens the heart. Good for the liver, gout, against swellings and skin diseases.

Louise: Eliminates headache, eye pain, pains from rheumatism. It is good for stomach disorders, helps in slimming diets. Preventing insomnia that derives from nervous fatigue.

Ladanies: Used as a sedative, antispasmodic, for the treatment of insomnia or diarrhea, toothache. Can further be used for rubs against colds and bronchitis, as well as tetanus.

Lavender (Lavandula angustifolia): Used for any type of pain, even for heart conditions, migraines, headaches, poor digestion and fainting. Can help in healing wounds, burns, acne, scabies. Lowers blood pressure, lessens the palpitations. Still used against clothing moth.

Marjoram:

Can resist and reduce stress, headaches, colds, tonsilitis, insomnia. It helps the body to expel toxins, bloating, indigestion and bellyache.

Fennel (Foeniculum vulgare): Relieves pain caused from arthritis, asthma, coughs, flatulence, abdominal pain, and can also stop the vomiting. It moreover aids the slimming procedure.

Melissa: A tonic for the heart, brain, digestive system, against melancholy. Soothing ability against neurasthenia, dizziness, ringing in the ears, asthma, neuralgia of the teeth and ears. Relieves abdominal bloating and pain caused by a wasp sting, or any other insect.

Mint: Highly antiseptic, drastically fights cold, cough, bronchitis, sore throat and flu. It has great digestive attributes and has the peculiarity of acting as a sedative in low doses and as an aphrodisiac in high doses. Mint tea is greatly a digestive and tonic beverage.

Mallow: Can be used for asthma, coughs, laryngitis, sore throat.

Passion Flower: It is soothing for the nerves and anxiety. It can act as both a sedative and a stimulant when nearing exhaustion. Slightly reduces blood pressure.

Pikrodialeta: Lowers blood sugar and triglycerides.

Micromeria juliana: It can kill worms and parasites in the intestines, and stop the nose from bleeding, as well as hemorrhoids. Heals wounds and ulcers. Used for colic and kidney stones.

Maidenhair: Can be used as a hair reatment to stop hair loss and prevent dandruff. Soothing in cases of bronchitis, runny nose, dry cough, asthma and basic colds.

Oregano (Origanum vulgare): Mainly for food, can also be used for tooth aches and rheumatism, intestinal disorders and abdominal pains. Stops diarrhea.

Sedge: Soothing for pulmonary pains. Can be useful against depression, insomnia, stomach ulcers, intestinal parasites, dyspepsia, as well as burns, wounds and insect bites.

Ceterach: Can dissolve kidney stones. It is an expectorant, a sedative, and a diuretic.

Dandelion: For cholesterol, skin irritations, swelling, heartburn, pain in the liver, arthritis, diabetes and fever.

Lime: Can help in calming the nerves, migraines, neuralgia, dizziness, insomnia. For coughs, colds, vomiting, rheumatism, arthritis, indigestion.

Mountain tea: For flu and sore throat. Toning the body and brain, good for arteriosclerosis, headaches, diarrhea and thalassemia.

Nettle: Dissolves uric acid. Valuable against gallstones. It's good for bleeding, hematuria, anemia, weakness of the body, arthritis, cystitis, diarrhea. It also increases the milk quantity of nursing mothers and stops hair loss.

Hyssop (Hyssopus officinalis): Used for blood pressure, asthma, indigestion, period pain, as a gargle for sore throats as well as a nerve tonic.

Sage: Calms the nerves. For depression, pharyngitis, cough, hoarseness, hypotension, diarrhea, tonsilitis, insect bites. Very significant for those with sweaty hands and armpits, as well as circulatory problems. Reduces the milk production in lactating women and prevents hair loss.

Chamomile: Calming the nerves, migraines, neuralgia, dizziness and insomnia. Heals burns and pimples. Relieves skin rash, itching, toothache, coughs, colds, flatulence, hemorrhoids, cramps, pain in the ears and mouth soreness.

The following are considered as native Mediterranean plants:

- Ajwain (Trachyspermum ammi)
- Anise (Pimpinella anisum)
- Coriander (Coriandrum sativum)
- Cumin (Cuminum cyminum)
- Mahaleb (Prunus mahaleb)
- Myrtle (Myrtus communis)
- Fennel Flower (Nigella sativa)
- Arugula (Eruca sativa)
- Rosemary (Rosmarinus officinalis)
- Rue (Ruta graveolens)
- Sage (Salvia officinalis)
- Saffron (Crocus sativus)
- Sumac (Rhus coriaria)

5. Module Summary

The main outcomes of this section are the following:

• The separation of the different branches of Botany, and a thorough understanding knowledge of the purpose of this industry. but mainly the usability of Botany and its role in our everyday life.

• Knowledge of how herbs are separated. The main aspects presented in chapter 3 include the methodology used for classification, the 5 kingdoms, the taxonomic groups as well as the way of naming herbs are the main results presented in Chapter 3.

• A short reference to the background and history of herbs. More detail on acknowledging the different types of herbs as well as their utility and usability as therapeutic aids.

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SECTION 2: PRODUCTION PLANT NURSERY, PROCEDURES – TECHNIQUES – PRACTICALITIES

1. Introduction

A plant nursery is the place where plants are produced and propagated, and further grow into the desirable size ready to be used. Propagating plants in nurseries can be achieven through different ways depending on the plant and the desired outcome.

The main objective of this section is for participants, having completed their training, to be able to:

3. Perform the whole process of plant reproduction by propagation from the plant seed or by transplanting the plant shoot.

2. Procedures

Regardless of the type of nursery / all are intended for the production and propagation of plants. Propagation material includes seeds, bulbs, tubers, rhizomes, seedlings and general plant parts (such as cuttings and rootstocks) which are intended to produce plants. Even whole saplings, grafted or not, that are produced and used for agricultural purposes can be regarded as propagation material.

The methods of propagation of plants can be classified as follows:

2.1. Native (tribal) Propagation:

Requires the participation of both male and female germ cells form the subsequent formation of seeds. Plants grown from a seed combine characteristics of both plant-parents. (Read more ...)

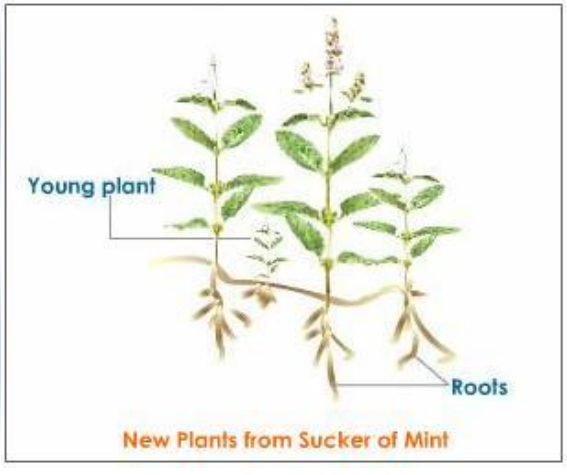
2.2. Asexual (vegetative) propagation

Refers to the ability of plants to proliferate using specific parts, without the mediation of fertilization. Plants generated in this manner are identical to the parent. They are divided into natural and artificial.

2.2.1 Natural asexual propagation

Suckers

Shoots that grow at the base of the plant at the existing root system and gradually develop their own independent root system. They may be severed from the parent plant together with their roots and cultured as individual plants.



Stolons

Modified shoots that grow horizontally on the soil surface (Shoots 'rotors' / Runners) or immediately below it, and have the ability to form new independent plants or at their end points or at the points where their eyes exist.

Bulbs, Tubers, Corms, Rhizomes

They are modified and reproductive parts of the root system of specific plant species.

Scion Plants (Adventitious plants)

They are small plants that fully grow up within the mother plant, which gradually develop their own root system and can develop autonomously. It can be observed in species of Kalanchoe, Tillandsia, genre and certain types of orchids and aquatic plants.

2.2.2 Artificial asexual propagation

Cuttings

They are parts of the plant (leaves and stems) which under certain conditions can form a root system and grow into new plants.

Division

Refers to plants that develop tubers, bulbs, stems and rhizomes.

Layering

Method in which part of the plant is planted while it is still connected to the initial plant, until it forms its root system, which is when it is being separated from the mother plant. On air layers, the process of rooting of the selected strain occurs with specific methods, at a point of the plant which is not in contact with the ground. The layers are also part of the natural vegetative propagation, since in many hanging plants, the production of roots in branches that touch the ground has been observed

Vaccines (Grafting)

A technique widely applied in commercial crops, in which a portion of a crop plant is 'transplanted' in a rooted plant and then developes thereon.

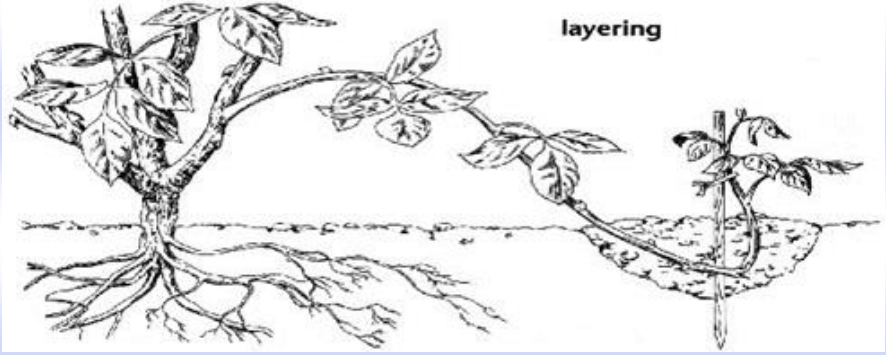
Tissue culture

It is the process of reproduction of the plant with cells of unreproductive parts, by using specific and specialized laboratory techniques.

2.2.3 **Apomixis**

It is the natural process of seed formation and embryo from the egg without the fertilization being mediated by male germ cells, which has been described in more than 300 plant species. There is only a single report on a "male type" apomixis regarding the plant Cupressus dupreziana. Plants from apomixi retain the characteristics of the original plant.

This includes reproduction by spores observed in certain species of fern, as well as the bulblet formation, which is typical among other species of the genus Lilium.



3. The Seed

3.1 General

A seed or sperm is a multicellular structure, with which the gymnosperms and angiosperms are being dispersed. It derived from fertilization and differentiation of the germ stem.

It is considered as a very important evolutionary feature of angiosperm and gymnosperm plants, which contributed to their prevalence in the plant kingdom, since its durable design allows it to remain alive for very long periods in order to "choose" the most suitable natural environment for the germination and growth of the new plant. The time required for seed formation varies depending on the kind, from a few days (some grasses) up to 3 years (some gymnosperms).

The seeds of angiosperms are surrounded by aril – a multicellular structure derived from the development of the ovary, or sections of it, and serves primarily for transporting and protecting the seeds. In gymnosperms, on the other hand, a fruit is not formed to surround the seed.

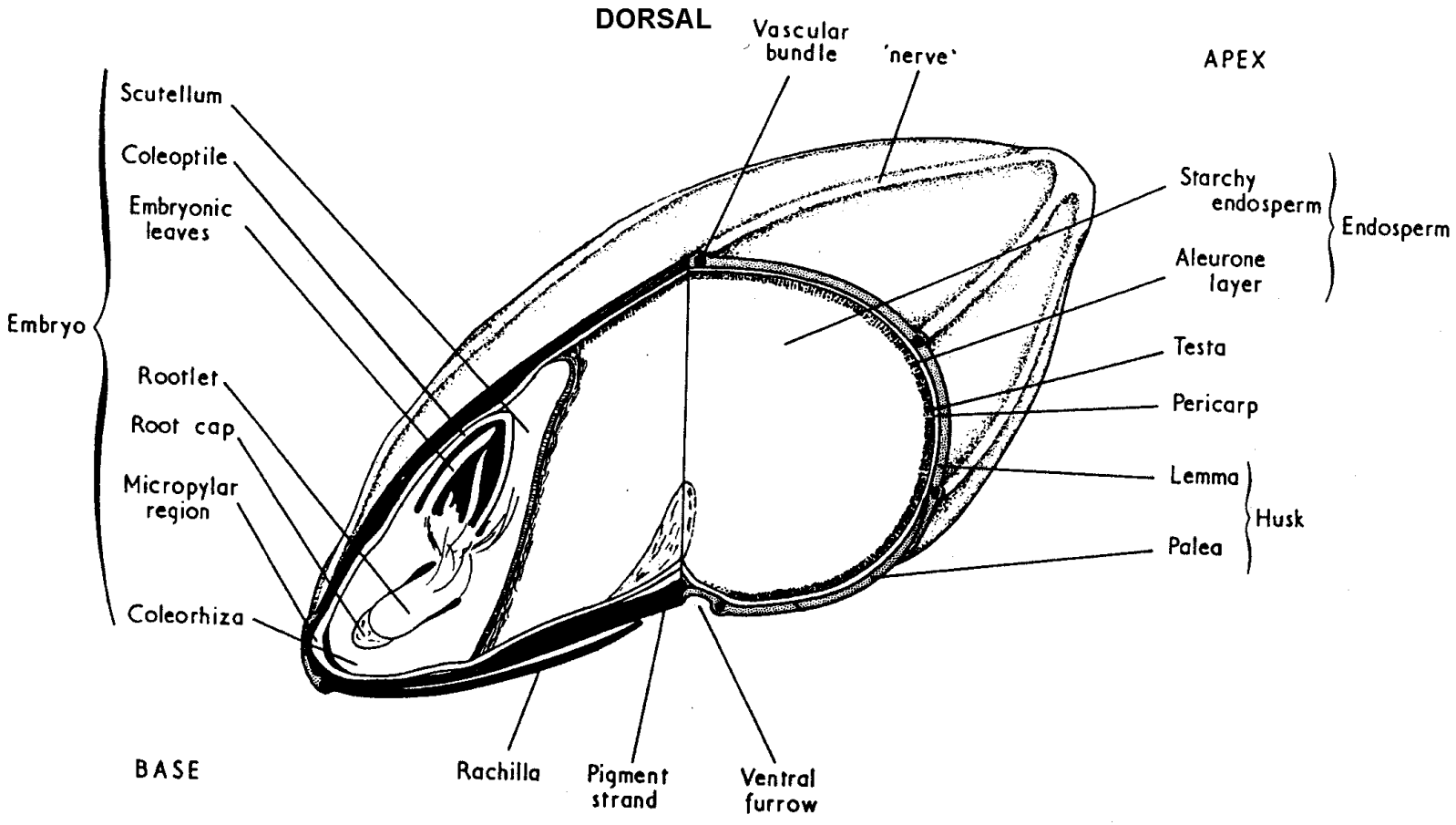

DORSAL
Vascular bundle
'nerve'
APEX
Scutellum
Coleoptile
Embryonic leaves
Embryo
Rootlet
Root cap
Micropylar region
Coleorhiza
Starchy endosperm
Endosperm
Aleurone layer
Testa
Pericarp
Lemma
Husk
Palea
BASE
Rachilla
Pigment strand
Ventral furrow
VENTRAL

Figure 1.

The seeds are substantially the mobile form of plants, which are generally characterized by the absence of movement. The transfer of a seed from the parent plant to the point where the new plant willl grow, which may be miles away, is called disperse, and most plants have produced mechanisms to safeguard this prodecure.

Thus, the seeds are dispersed either through the mother plant (autochory - eg the fruit has ballistic capability) or by air (anemochory), water (hydrochory) or animals (zoochory). In most cases, mechanisms have been developed in order to facilitate the dispersion of the seed. Many seeds acquire flying wings, fimbriae or low weight so as to facilitate the dispersion in the air. The may also bear brackets, or the fruit which surrounds them serves as animal food, in order to ensure the dispersion, or even float so they can be transferable through water etc.

3.2 Structure

The form and composition of the seed shows large variation depending on the class or family, but in any case, the basic structure of the seed includes:

- The fetus
- The nutritious substances
- Seminal casing or shell

The angiosperms have developed a complex mechanism of double fertilization, in which a male cell unites with the oocyte of the female germ cell for the creation of the embryo, while another male cell unites with the diploid nucleus of the female germ cell for the creation of the endosperm, which provides nutrition and is a triploid (the 2/3 of the genome comes from the female germ cells). In some species, throughout the development of the embryo, the endosperm almost degenerates and the cotyledons are substantially the only organs storing nutrients. In gymnosperms, the storage tissue derives only from the female germ cells (1n).

In some species, the endosperm is surrounded or substituted by the perisperm, which also accounts for providing nutrition, while externally there is a shell.

The embryo is a plant miniature and it consists of:

- The cotyledons (with nutrition providing role). One in monocotyledonous (usually referred to as scutellum), two in dicotyledons, two or more in gymnosperms

- The embryonic axis with two developmental poles, located anti diametrically, the radicle and the blastocyst (Coleoptile in monocotyledons).

The part of the embryonic axis between the cotyledons and the radicle is called the hypocotyl, while the part of the embryonic axis above the point of contact with the cotyledons is called epicotyl.

3.3 Germination or Seed Sprouting

Germination or sprouting is the process of the embryo developing, drawing nutrients from the storage tissue, which begins with water uptake by the seed, and technically ends with the appearance of the radicle. It is followed by the development of the whole embryo into a young plant. Often, vegetation refers to the overall development process of the embryo into a young plant.

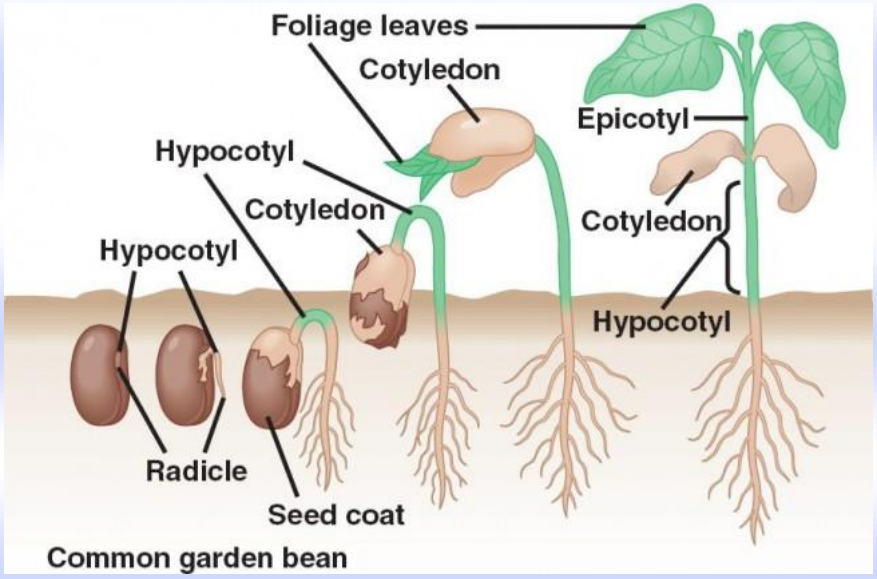
3.3.1 Process

The germination process, as indicated above, begins with water uptake by the seed. The seeds of most plants during their maturation stages become dehydrated. To initiate germination, the seed must be rehydrated. Water uptake, if the fetus is alive, triggers a series of biosynthetic processes, leading to a rapid increase of the fetus, a rupture of the covers and finally the appearance of the radicle.

Vegetation - in the sense of a new plant emerging from the ground - can be underground or overground. In underground vegetation, after the root elongation, the cotyledons remain on the ground while the epicotyl is being extended, drawing the blastocyst to the surface, which then further develops.

In overground vegetation, after the root elongation, the elongated hypocotyl and cotyledon come to the surface together with the end of the blastocyst, which then further develops.

In monocotyledonous plants the small root (koleorizo) firstly elongates - the case in which the radicle initially grows. The radicle then is being released and operates for the first time in the plants life as a regular root, which is later destroyed and blastogenic roots are created from the base of the shoots. After the increase in the radicle, there is an increase in the coleoptile and the first leaf emerges from the ground.



3.3.2 Conditions

For the germination of the seed there should be appropriate conditions, ie:

- Maturity of the seed

- Appropriate environmental conditions (proper temperature, adequate concentration of oxygen, adequate lighting)

3.4 Dormancy

Dormancy refers to the situation in which some grains, although they are alive and under preferable conditions, do not germinate.

The seed dormancy is considered to be an evolutionary characteristic of plants in adapting to prevailing environmental conditions, so that the seed can germinate only when the conditions for the development of the new plant are suitable. Dormancy also provides the necessary time for successful seed dispersal and prevents germination of seeds near the parent plant or before they are released by it.

3.4.1 Causes

Dormancy may be caused due to characteristics of the embryo or the seed coat. The major causes of dormancy are:

- The impermeability of the coat in water or in air

- The resistance of the coat to the fetal increase

- Uncured (undeveloped) fetus

- The existence of chemical inhibitors of vegetation - such as dormancy - of the actual fetus or the coats. The abscisic acid is considered as a significant inhibitor of vegetation (abscisic acid - ABA), a hormone that inhibits the growth, which is concentrated in the embryo during seed maturation in the maternal plant. In contrast, another class of hormones, gibberellin (gibberellin - GA) can aid the germination of the embryo. An increased ratio of ABA / GA accounts for a fetus during dormancy, while a reduced ratio of ABA / GA accounts for a fetus with enhanced growth potential. ABA affects the characteristics of the coat (thickness), while GA affects the growth potential of the embryo, as well as the endosperm.

- A combination of all the above.

3.4.2 Taxonomy

Various forms of dormancy classification have been proposed, with the most recent classification system being proposed by M. G. Nikolaeva (1967), as developed by C. Baskin and J. Baskin (1998; 2004), which is hierarchical and includes 5 classes, which are further separated into levels and types. Under this system, dormancy is taxonomized as follows:

- Physiological dormancy: Usually due to the existence of vegetation inhibitors, which occurs in many angiosperms and most of the gymnosperms. In nature it is eliminated with the change of seasons, while artificially for the dormancy to be lifted, the sperm must undergo a period of cold or hot lamination. In some species it is lifted by applying gibberellin acid or by scarification.

- Morphological dormancy: Due to the immaturity of the embryo, which has been formed, but not yet acquired the proper size to germinate, usually in seeds with a small embryo and a rich endosperm. It occurs in both vascular and gymnosperms. From an evolutionary point of view it is considered to be the most primitive kind of dormancy.

- Morpho-physiological dormancy: A combination of the previous, characterized by the presence of inhibitors and immature seeds. It occurs in both angiosperms and gymnosperms.

- Natural dormancy: It is found only in angiosperms, due to the impermeability of the coats in water. Can be lifted when an agent makes the coats permeable to water. Such agents in nature may be high temperatures, temperature fluctuations, fires, an animal's digestive system etc.

Artificially, dormancy can be waived with an injury of the seminal coat (scarification), with the use of mechanics (cutting the edge, filing, sanding), or with thermal (immersion in hot water) or chemical (application acids) means. When dormancy is waived, the seed can be germinated in a wide range of environmental conditions. Unlike the case of seeds with physiological dormancy, which may have a secondary dormancy period and, if conditions are not favourable for germination, when natural dormancy is waived and the coats become permeable to water, they cannot return to their previous state. Therefore, the mechanism for waiving dormancy must be harmonized with environmental conditions to enable the development of the new plant.

- Combinational dormancy: A combination of physical and physiological dormancies.

4. Grafts

Refers to the propagation by cuttings, which is the most common way of asexual reproduction and often applies in a variety of species. It is a relatively easy and quick process which provides plants that retain the exact characters of the parent plant, ie the plant from which the graft was cut. The inoculated shoots which develop their own root system and then further develop as independent plants, under specific circumstances.

Plants, like most living creatures, develop a fetal tissue (callus) in places where the tissue has been injured, in an attempt to heal it. This tissue under specific conditions of humidity, temperature and light can be converted into a root system.

4.1 Ways of Discriminating Cuttings

Depending on the period the cutting takes place, they are divided into:

‘Herbaceous’: These are cuttings cut during the first period of vegetative growth of the plants during spring time, when the shoots are soft and green. Usually occurs from March to May.

'Hardwood: These are cut during the dormancy period and after the plants have fully developed, usually from October until February.

"Softwood': Are the cuttings cut during the second growing season, when the shoots are already developed and the plant growth has slowed, usually between June and September.

Depending on how easily they can be cut, they are divided in three ways:

By cutting with a vertical section of a twig, 2-3 mm below a node.

By tearing off a branch from another existing branch.

By detaching the cutting twig from the existing branch with two oblique incisions, so that at the base of the cutting. a section of the older piece of wood will still exist.

4.2 Reasons for applying vegetative propagation

- Inability to produce vital seeds
- The inability to reproduce offspring genetically identical to the parent plant
- To maintain a particular characteristic of the plant
- Increased production of plants
- Developed resistance to pathogens
- Environmental adaptation
- Controlling the vigor of vegetation

4.3 Factors affecting reproduction of plants by cuttings:

- Parent plant
  - Natural state of parental plant
  - Shading
  - Trenches

  - Age of the plant
  - Wood type
  - Viruses
  - Cuttings collection period

- Treating grafts
  - Growth regulators → IAA, IBA, NAA - Methods of application of auxins
  - Vitamins
  - Minerals
  - Fungicides
  - Injuries

- Environmental conditions
  - Water
  - Temperature
  - Light
  - Rooting substrate

4.4 Propagation process by cuttings:

We choose young, healthy plants, free from deformities and diseases. From those, we choose the strongest shoots that are free from flowers or fruits.

Cut the cuttings in length of 10-15 cm from branches with a 3-5 mm diameter.

Cut the bottom side of the cutting 2-3 millimetres below an eye.

After the cuttings have been acquired, the leaves must be removed, if leafy, from the base of the cuttings up to 2/3 in height. In cuttings with large leaves the remaining leaves must be removed so that eventually their transpiration is drastically reduced. (a way of measuring is by keeping foliage of which the length does not exceed 1/3 the length of the cutting). IT is essential that the intersections of the cuttings to be pure, with the pruning shears well sharpened and disinfected, so that no diseases may be transferred.

After the cuttings have been obtained, to increase the chances of rooting them, they need to be placed in rooting hormone.

2-3 inches of the base of the cuttings must be immersed, after they are sprinkled with some water, in rooting hormone.

Finally, the cuttings are placed into a lightweight soil mix, usually prepared by mixing or using individual peat, sand and perlite. These materials allow good ventilation, despite the continuous use of water.

Cuttings obtained in autumn and winter are placed in a lightly shaded or even a bright place. The cuttings need to be watered and sprayed with water regularly to prevent dehydration and dryness, without overdoing it. Excessive watering can result to poor ventilation of the plants and the development of fungal diseases. The frequency of watering depends on the season, temperature, exposure to light, etc.

5. «Bulbous Plants»

Bulbous are usually the species of herbaceous plants that are mainly characterized by the presence of modified organs, with storage and reproductive role. The term "bulbous" might be considered as inappropriate, since most of them do not develop actual bulbs, but instead have trunks, roots and tubers, structures with significant morphological differences between them.

5.1 Bulbs

They have the well-known characteristic structure of the onion, with numerous concentric scales, which are held at the base of the bulb by a flat formation called basic disk or plate. From the bottom surface of the base disc roots are formed. In some species, the bulb is externally covered by a thin lamina called intima, while internally there is the stem of which the overground portion of the plant is formed.

Plants with true bulbs include the following:

- Lily
- Snowdrop
- Hyacinth
- Tulip
- Nerine
- Narcissus
- Onion, garlic and other species of the Allium genus
- Amaryllis
- Certain types of iris (Spanish – Dutch Iris)
- Sorrel
- Belamcanda
- Sternbergia

5.2 Logs (corms intended)

Externally, they resemble bulbs, both on their coating, and the basic disk, but differ from them internally, since they are compact and lack the concentric scales of the bulbs.

Plants with logs include the following:

- Saffron (C flavus, C. sieberi, C. vernus)
- Gladiolus

- Colchic
- Dierama
- Freesia
- Banana tree
- Sparaxis
- Ixia

5.3 Tubers

Differ morphologically from both bulbs, and trunks. They are compact, soft formations from modified shoots / stolons (stem tubers) or portions of the root (root tubers) and may be underground or overground.

Plants with tubers include the following:

- Begonia
- Cyclamen
- Dahlia
- Gloxinia
- Furnaces
- Buttercup
- Potato
- Sweet potato
- Caladium
- Anemone
- Eranthis
- Ficaria

5.4 Rhizomes

They swollen underground stems, which have the ability to form roots and shoots at the positions of their eyes. Despite their similarities with stolon, there are specific morphological and functional differences that determine their differentiation.

Plants with rhizomes include the following:

- Canna
- Calla
- Certain types of Iris (German Iris)
- Bamboo and grasses
- Dionaea
- Bubble plant
- Ming
- Agapanthus
- Ginger
- Bergenia
- Alstroemeria
- Hops
- Asparagus
- Populus tremuloides

6. Module Summary

The main outcomes of this section are the following:

- Knowledge of the two major types of plant propagation, sexual and asexual
- Knowledge of all three categories of vegetative propagation, as well as their subcategories
- Knowledge of all information and data concerning the most prevalent methods of plant propagation, as well as all their main characteristics. Seeds - Grafts - Roots

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SECTION 3: PROCEDURES- TECHNIQUES- PRODUCTION PRACTICES IN NURSERY

1. Introduction

There are various types of nurseries, each with its own purpose and role. Procedures, techniques and practices used in the production and proliferation of plants depend on the type of nursery.

The main objective of this section is for participants, having completed their training, to be able to

4. Perform all the relevant techniques and practices for the cultivation of different plant species and plant diseases prevention.

2. Types of Nurseries

The different types of nurseries are divided according to their function, way of production and proliferation as well as the purpose for which they work. The main types of nurseries are the following:

- Retail Nurseries for sale to the general public
- Wholesale Nurseries for sale in large quantities and primarily in companies
- Special nurseries that specialize in a specific plant or plant category
- Forest Nurseries for replenishment of forest destruction
- National Nurseries for the maintenance and propagation of national plants
- Private Nurseries for private foundations and estates

Although the popular image of a nursery is that of a retail nursery, the range of nursery functions is far wider, and is of vital importance to many branches of agriculture, forestry and conservation biology. Some nurseries specialize in one phase of the process: propagation, growing out, or retail sale; or in one type of plant: e.g., groundcovers, shade plants, or creepers. Some produce bulk stock, whether seedlings or grafted, of particular varieties for purposes such as fruit trees for orchards, or timber trees for forestry. Some produce stock seasonally, ready in springtime for export to colder regions where propagation could not have been started so early, or to regions where seasonal pests prevent profitable growing early in the season.

3. Field and Container Nursery Production

3.1 Field Nursery Production

Field nurseries are the traditional method of producing and marketing ornamental trees, shrubs, fruit trees, and perennial flowers. Until the mid 1900s nearly all nursery crops were produced in the field. Even with the advent of above-ground container production and pot-in-pot, field nurseries are still widely used. Some of the advantages of field production over other production methods: less demanding in terms of maintenance and labor during the growing period, plants do not require winter protection, and lower start-up costs.

3.1.1 Production Considerations

Site selection: The primary consideration in selecting a site for field nursery production is the soil. Not only must the soil be well-drained, but it must hold together around the roots when plants are dug for ball-and-burlap. Production of bare-root plants requires a soil that will easily fall away from the roots. Fields should also be free of large stones or hard pans that could interfere with root development. A source of clean, pest-free water is another important consideration. The ideal site

will have a slightly sloping topography for proper air drainage and offer water drainage to a pond or retention basin for recycling back to the crop. Potential growing sites should be tested for soybean cyst nematode infestation as the presence of this pest in the soil could severely limit out-of-state export.

Maintenance: Shade trees are often top-pruned in both winter and summer to ensure that a central leader is maintained and the shape of the head of the tree is in proportion to the trunk. Shrubs are pruned regularly to establish a height and density for the planned market. Plants grown for the landscape trade tend to require specialized pruning. Inexpensive plants for the discount trade may be allowed to grow looser and taller before pruning, thus enabling them to get to size quickly. Trees may need to be staked to maintain a straight trunk. Some growers root prune either routinely or prior to harvest to help trees survive digging and transplanting.

Pest management: Methods of weed control can include a combination of hand weeding, mowing, mechanical cultivation, mulching, ground cloth, and chemical methods. Insect and disease management requires integrated pest

management (IPM) strategies, such as planting resistant cultivars, scouting, and practicing best management practices.

Harvest: The time it takes for plants to reach a saleable size will vary depending on the type of plant and growing conditions. In most ball-and-burlap operations, plants are harvested 3 to 5 years after planting. Nursery crops grown in-ground are ideally harvested during the dormant season to minimize transplant stress; however, it is not uncommon for digging to continue through the summer as well. Harvest is also determined by the stage of development to be marketed. Plants may be sold as liners, whips or finished plants. The term Liner refers to any plant placed (‘lined out’) into a production system so it can be grown to a larger finished plant. Whips are plants consisting of a straight stem with little branching. Finished plants, the final stage of production, have all the characteristics expected in the market place: form, size, branching, and trunk size. Plants are harvested either by hand or with a mechanized tree spade.

3.2 Container Nursery Production

The container nursery business involves the production and marketing of ornamental trees and shrubs, fruit trees, and perennial flowers grown in above-ground containers.

This production method has helped revolutionize the nursery business in the last few decades. Some of the advantages of container production include:

- less acreage required for production,
- handling convenience, and
- a nearly year-round harvest and planting season.

3.2.1 Production Considerations

Site selection: Container-grown plants need to be frequently irrigated, often multiple times per day, throughout the growing season. A source of clean, pest-free water is probably the most important consideration in selecting a suitable site. Since container production entails growing plants above ground using customized soilless growing media, the type of native soil at the site is not nearly as important as it is with field-grown crops. In general, container

production requires a firm surface with good surface drainage. The ideal site will have a slightly sloping topography for proper air drainage and offer water drainage to a pond or retention basin for recycling back to the crop.

Crop selection: Nursery operators may choose to either produce their own planting stock or purchase seedlings and cuttings from other growers. Most nurserymen grow a variety of plants with known high market demand; others may specialize. Some specialty nurseries grow native plants or uncommon cultivated plants. This type of specialized production can serve niche markets and is especially well-suited for the small grower.

Maintenance: Pruning trees and shrubs in the production system is both an art and a science. Shade trees are often pruned in winter and summer to ensure that a central leader is maintained and the shape of the head of the tree is in proportion to the trunk. Shrubs are pruned regularly to establish a height and density for the planned market. Plants grown for the landscape trade tend to require specialized pruning. Inexpensive plants for the discount trade may be allowed to grow looser and taller before pruning, thus enabling them to get to size quickly. Trees may need to be staked to maintain a straight trunk.

Pest management: Weed control in nurseries requires efficient and effective management. Methods of control can include a combination of hand weeding, mowing, mechanical cultivation, mulching, ground cloth, and chemical methods. Insect and disease management requires integrated pest management (IPM) strategies, such as planting resistant cultivars, scouting, and practicing best management practices.

Harvest: Nursery crops grown in containers can be harvested any day of the year. The time it takes for plants to reach a saleable size will vary depending on the type of plant and growing conditions. In general, container-grown plants may be in propagation for 6 to 12 months. Plants then spend one year as a 1-gallon plant and one more year as a 3-gallon plant, for a total of 30 to 36 months. The length of time a plant can be grown in a container is limited. Once unsold plants outgrow their container, they will have to be repotted to a larger container or discarded. Harvest is also determined by the stage of development to be marketed. Plants may be sold as liners, whips, or finished plants. The term Liners once referred to plants after one year of production from seed, cuttings, or tissue culture. Today this term refers to any plant placed (‘lined out’) into a production system so it can be grown to a larger finished plant. Whips are plants consisting of a straight stem with little branching.

Finished Plants, the final stage of production, have all the characteristics expected in the market place: form, size, branching, and trunk size.

Labor requirements: The level of management for container-grown plants is significantly higher than in field production. A common rule of thumb is to employ one worker per actual acre of container production.

4. Greenhouses

4.1 Definition

The greenhouse is a roofed and enclosed space that aims to protect plants from the cold of winter.

Greenhouses may be constructed on permanent iron skeletons of glass or may be of plastic, mounted on a wooden frame. The construction of greenhouses depends on the climatic conditions prevailing in the winter months in an area and as well as the type of plants to be grown. The greenhouses of northern countries have heavy constructions and often consist of double glazing and double roof. These greenhouses are heated. In contrast, in the southern regions of Greece, such as southern Messenia and Crete, the building of the greenhouses is very lightweight, made of plastic stretched over a wooden frame and has no heating.

Plants that cannot thrive in an open space during winter are grown in greenhouses. In recent years the technique of growing plants in greenhouses has developed significantly. As a result, products such as tomatoes, eggplants, zucchini etc., are produced in Greece all-year round and cover the needs of the Greek market, while a great deal of them is exported. Furthermore, flowers that thrive

only in summer or flowers of tropical countries that would otherwise be impossible to cultivate, are grown in greenhouses. Such flowers are e.g. orchids requiring temperature above 28 ° C and high humidity, something that cannot be achieved outside the greenhouses.

In recent years another type of greenhouses, known as chemical greenhouses, is being developed. These are nothing more than a foam-like chemical substance, which is sprinkled all over the plants in very large areas. This chemical substance completely covers the plants and thus protects them from the cold. It works namely in the same way as plastic greenhouses. This method is still in a research and experimentation phase and, according to the views of researchers, will solve the problem of mass cultivation of off-season crops.

4.2 Produced Products

The products produced in a greenhouse belong into two major categories:

a) Groceries (especially fruits and vegetables) and

b) Ornamental plants (mostly pot plants and cut flowers)

These products are nowadays one of the most dynamic sectors of Greek agriculture, in terms of ensuring income and exports.

The social changes that have occurred in Northern European countries and later in our country, such as the growing urbanization of the population (which does not allow the production and own consumption), have a positive impact on demand for horticultural products. At the same time, the turn of humanity from muscular work that requires a high-calorie diet to mental work that requires a diet with few calories but rich in vitamins and minerals, has led to an increase of demand

throughout the year for vegetables and fruits in wide range. This of course means an increase of demand for greenhouse products. Additionally, the removal of man from his natural environment with urbanization creates the need for a replacement of the natural environment, which is typically the decoration of the exterior and interior of urban residence with plants. However, these plants are not necessarily the same with that developed in the natural outdoor environment. They are usually more adapted to the limited light and different temperature of the room. Therefore, a demand for ornamental plants propagated and grown in a controlled greenhouse environment is created.

Nowadays there is a considerable demand for these products, especially a demand for products with better quality and appearance.

It should also be noted that the greenhouse products produced in our country are more complementary to the open field crops, rather than competitive products. For example, the most of the greenhouse horticultural products are produced in winter, while the horticultural products of the open field are produced in summer.

The large volume of greenhouse horticultural products produced in northern countries, coincides more with the corresponding open field crops produced in our country and less to greenhouse crops. Therefore, in the markets of northern Europe, which are the major consumption centers, there is no problem of significant competition between their products and the Greek greenhouse products. There is, however, a problem of competition between the Mediterranean countries as they all try to improve their exports into the markets of northern Europe.

The prices of greenhouse horticultural products are usually high in recent years because the demand is greater than the supply. Market research also shows that high prices do not affect the demand for high-quality greenhouse products.

4.3 Outcomes

- Avoidance of damages caused by wind, rain, snow and hail.
- Depending on the equipment, it is possible to regulate the environmental factors of the crown of the plants, such as radiation, heat, humidity and carbon dioxide, with sufficient accuracy.

- It is possible to regulate the environmental factors of the root of the plants, such as moisture, oxygen, heat, inorganic nutrients and ph. These factors with the use of appropriate soil or hydroponic substrates can reach accurately the plant requirements.

- It is possible to protect plants effectively from diseases and insects, due to limited space and specialized equipment. Furthermore, in a greenhouse where the environmental conditions can be precisely regulated in order to be conducive to plant growth, the development of plant diseases is much rarer than it is in conditions that do not provide such a capability.

Especially in greenhouses where the environment of the plants is simply modified only through the building, without any specialized equipment, we usually have:

- Early or late crop production and
- Avoidance of damages to the plants caused by wind, rain, hail etc.

In greenhouses where the environmental conditions are precisely regulated through specialized equipment, we can achieve:

- Scheduling of production, to be sent to the market at a given time, regardless of weather conditions that will prevail in the outside space,

- Improved quality and increased production due to improved environmental conditions and protection from the harsh weather offered by the greenhouse.

4.4 Greenhouse Equipment

Dynamic vacuum ventilation system with fans

- Special design for ventilation of agricultural facilities
- High air flow (33.200 - 40.800 m3 / h) with a relatively moderate electrical installation
- Air velocity inside the space is low so as not to cause unwanted currents
- The air distribution is uniform, without the use of airways
- The installation cost is low

Cooling System

- Reduces the room temperature by evaporation, while simultaneously increases moisture

- Ideal method of cooling in high temperature and low relative humidity (almost everywhere in Greece)
- Reduces the temperature to 14 ° C

Heating System

Fogging/Misting System

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- A combination of devices and arrangement after a careful planning in order to get the best result
- Applications for each crop

5. Hydroponics

5.1 Definition

Hydroponics is a technologically advanced method of growing plants without the use of natural soil. Internationally the use of this method is constantly expanding. In Greece, this method is not widely used, and when is used, it is doubtful whether it is rationally used so as to make full use of the possibilities offered.

By the method of hydroponics plants are grown either on porous inert substrates, to which nutrient solution is added, or in neat nutrient solution.

Hydroponic growing is internationally an ever-expanding activity because by optimizing the root environment, it increases crop yields and improves product quality. Besides that, it provides the ability to cultivate plants in areas with very poor soils (very salty, very consistent, etc.) or in locations with no natural ground.

In general plants, in order to grow properly, need to have in their roots plenty of oxygen and plenty of water containing all the necessary dissolved inorganic nutrients in the correct ratio. In conventional

soil cultivation is difficult to achieve this combination. In natural soil, in most cases, the more water is present, the less oxygen is left and the opposite. As a result, sometimes the one element and sometimes the other one are in shortage. On the ground also important is the problem of the availability of inorganic nutrients to the root of the plant. Inorganic nutrients may be added in the soil, but are not always readily available to the root, because they are bound to components of soil or hardly moved to the root. Hydroponics solves these problems by regulating the supply of the nutrient solution and by using (when solid support is used) chemically inert materials with a very high porosity.

Besides the ability for cultivation in an improved root environment, hydroponic crops provide some other benefits as well, such as:

- Elimination of plant diseases caused by soil and thus elimination of the cost of decontamination, which is usually important
- Conservation of water and nutrients because losses from surface spills and deep water penetration in the soil are limited

- Prevention of groundwater contamination with heavy elements (especially in closed systems)
- Technically easier adjustment of the thermal environment of the root
- Creation of a pleasant environment for the employee through the isolation of soil and thus the absence of odors and dust
- Limitation of hard manual labor, which is necessary in land crops such as the soil treatment
- Simplification of the work program of the production company, because soil improvement, creation of special soil mixtures for developing seedlings, weed control etc are not required

The major drawbacks of the hydroponic crops are summarized as follows:

- They are relatively sensitive farming systems with no room for many mistakes
- Hydroponic cultivation, especially when it takes place (as is usually the case) in the greenhouse, requires greater technical skills

The soil allows the roots to grow in size in a large area, something that does not happen in hydroponic systems. In hydroponic systems, however, almost the entire root surface is covered continuously by nutrient solution. Therefore, a lack of nutrients (if these have been added by the grower) is a rare phenomenon. This is particularly true in closed systems.

In hydroponic systems cleaner forms of fertilizers are used, in order to be completely water soluble.

The treatments of plants grown hydroponically differ from those of plants grown in soil, in terms of creating the environment of the root.

The treatments of plants grown hydroponically, in terms of creating the environment of the crown, are identical to those of plants grown in soil, e.g. pruning, fertilization of flowers, plant protection of the crown etc.

In hydroponic crops the root functions in an analogous manner as in the case of land crops, but in hydroponics, because the availability of water and nutrients is very high and covers the entire surface of the root, almost all of the root surface is active concerning the absorption of nutrients and water. In hydroponic growing of tall plants the support of the plants is no longer based on the root but on a special support placed in the greenhouse frame or on the floor.

5.2 Hydroponics as food production process

The more world population increases and the more the urbanization of population proceeds, the more will the demand for fresh vegetables and fruits, which are essential to meet each person's nutritional needs, increase.

Growing plants in the absence of natural soil, at first glance, could be evaluated negatively, because it is a process that removes food production from the natural environment. Nevertheless, if we take into account that in order to meet the needs of humanity in food, we are forced to reclaim vast forest tracts, as well as the fact that continuous intensive cultivation of land contributes to the long-term destruction of this natural resource, and that in order to be able to continue cultivating a plant in the same soil, we have to use large amounts of chemical pesticides which often harm the health of consumers, then growing plants without the use of natural soil protects, in many cases, both the environment and public health.

The views that in hydroponics plants are grown in inorganic chemical solutions and therefore have an inferior nutritional value is simplistic, because in land crops, with the exception of organic

farming, plants are grown using chemical fertilizers as well. In fact, fertilizers used in hydroponics are much more pure and free of heavy metals.

Both in land crops and in hydroponics, the root is the filter controlling which chemical elements get into the organs of the plant.

Generally, hydroponic products do not differ in flavor from those grown in soil in the usual way. As a matter of fact, it is proved from the results of scientific research that hydroponic products contain exactly the same quantity of minerals and vitamins as the high-quality products of the soil.

6. Plant Diseases

6.1 Definition

A plant disease can be defined as any abnormality in form and physiology of a plant of sufficient intensity and duration so as to affect temporarily or permanently the normal development of the plant or the quality of its products. The causal agent of these changes is called pathogenic organism or simply pathogen. This causal agent can be a climatic factor or a parasitic organism, or more often a combination of non-living environmental factors and living agents. Despite the fact that the term “pathogen” can describe any causal agent of a disease, it is usually used for living organisms and viruses. Besides, term “pathogen” should not be confused with the term “parasite”, since many parasites do not cause diseases, while toxic products of a saprophyte can be the cause of a plant disease.

Pathogenicity is the ability of a pathogen to produce an infectious disease in an organism.

Pathogenesis is defined as the sequence of events by which a disease is manifested.

Susceptibility is the physiological state of a plant to manifest severe symptoms when infected by a pathogen.

Vulnerability is the physiological state of a plant that makes it weak to resist the attack of a pathogen.

Durability is the physiological state of a plant that allows it to resist the attack of a pathogen. It is, namely, the opposite of “vulnerability”.

Host is the plant on which a parasite or a virus is developed.

Allelopathy is the study of metabolites that are produced by higher plants, algae, bacteria and fungi and affect positively or negatively the growth and development of agricultural or biological systems.

6.2 Classification of diseases according to the transmissibility

Depending on the status of contagion, diseases are divided into communicable and non-communicable.

Communicable are the diseases whose causal pathogen is transmitted from plant to plant. They are caused by parasites and viruses.

Non-communicable are the diseases whose causal pathogen is not transmitted from plant to plant. They are caused by adverse ecological and meteorological factors.

Communicable diseases are divided into:

•Epidemic
•Endemic
•Sporadic

Epidemic is the contagious disease which develops periodically, in a centralized and intense way, and covers large crops. *Endemic* is the contagious disease, which is manifested in an area steadily every year but with a different intensity each time. *Sporadic* is the contagious disease, which spreads in a scattered way to the plants of an area.

6.3 Classification of diseases according to the cause

According to the cause plant diseases are divided into two major categories:

- Non-parasitic diseases. They are caused by:

- Soil conditions (lack or excess of nutrients, soil structure, soil moisture, soil reaction, etc.).
- Meteorological factors (high or low temperature, lack of oxygen, adverse lighting, hail, wind, etc.).
- Harmful substances in the atmosphere.
- Toxicity of pesticides

- Parasitic diseases. They are caused by:
  - Plant parasitic agents. That is species of the Plant Kingdom. Such plant parasitic agents belong to bacteria, fungi and spermatophytes.
  - Viruses. Viruses are nucleoproteins that have pathogenic capacity.

6.4 Fungi

- They are eukaryotic organisms classified under a separate kingdom (Kingdom Fungi).
- They reproduce via spores. Spores are transferred through air, water or soil.

- It is estimated that approximately 20 000 species of fungi are plant pathogens. Their exact formulation is generally difficult without the use of laboratory techniques. The usual practice is the rough approximation based on individual symptoms of infection.
- Symptoms include:
    - Leaf spot
    - Root rot
    - Stem rot
    - Rust
    - Powdery mildew
    - Anthracnose
    - Canker
    - Galls
    - Wilt
- Common genera of pathogenic fungi:
    - Alternaria
    - Armillaria
    - Ascochyta
    - Botrytis
    - Cercospora
    - Cladosporium
    - Colletotrichum
    - Erysiphe
    - Fusarium
    - Pelicularia

- Puccinia
- Rhizoctonia
- Sclerotinia
- Septoria
- Verticillium

6.5 Oomycetes

- They are eukaryotic organisms with morphological similarities to fungi.
- Symptoms include:

- Root rot
- Stem rot
- Crown rot
- White rust
- Downy mildew

- Common genera of pathogenic oomycetes:
  - Phytophthora
  - Pythium
  - Albugo
  - Peronospora
  - Plasmopara
  - Pseudoperonospora

6.6 Bacteria

- Prokaryotic organisms (Kingdom Bacteria).
- Phytoplasma are specialized bacteria.
- Symptoms include:
  - Galls
  - Rot
  - Leaf spot
  - Wilt

- Necrosis
- Canker
- Fire blight
- Witches' broom (Phytoplasma)

- Selected genera:
  - Agrobacterium
  - Erwinia
  - Pseudomonas
  - Xanthomonas

6.7 Viruses

- They are parasitic structures, not classified under any of the known kingdoms. They use the functions of normal cells to survive and replicate.
- They are often dispersed by insects or transmitted by direct contact.
- Infection is often asymptomatic. Possible symptoms are:
  - Stunted growth

- Discolored or deformed fruits, leaves or flowers
- Rot

- Selected viruses:
  - Impatiens necrotic spot virus (INSV)
  - Tomato spotted wilt virus (TSWV)
  - Tobacco ringspot virus (TRSV)

7. Plant Disease Management

7.1 Principles of plant disease management

- Avoidance: use or handling of environmental factors in the implementation of plant protection in order to profit from the absence, inability to infect or the interruption of the biological cycle of the pathogen.
- Exclusion: attempts to prevent introduction or establishment of a pathogen in an uncontaminated area.
- Eradication: elimination of a pathogen from an area in which it is already established.
- Protection: obstruction of economic damage in a crop by a pathogen by imposing a chemical or physical barrier between the inoculum and the plant. Protective measures should be taken either just before the appearance of the inoculum in plants or at the beginning of the incubation period.
- Therapy: application of physical or chemical means so as to destroy the pathogen into the plant.

- Development of resistance: handling of the morphology or physiology of a crop by improving the methods of selection or hybridization so that the pathogen cannot be established.

7.2 Plant defense mechanisms

7.2.1 Passive (constitutive)

- Structural components of the plant (bark, cell wall etc)
- Metabolites: chemical substances with toxic /antimicrobial activity (alkaloids, tannins, phenols, etc.)

7.2.2 Active (inducible)

Includes mechanisms that did not exist before the infection, and are induced by it.

- Basic resistance / innate immunity:
    - It is the first line of defense.
    - It is non-specific and recognizes molecular sequences often associated with pathogenic

microbes [microbe-associated molecular patterns (MAMPs)] that may be found in non-pathogenic microbes as well.

- Eliminates the majority of pathogens.
- Among the basic defense mechanisms is the increase of the thickness of the cell wall at the point of infection.
- Certain pathogens synthesize effector proteins that are able to suppress basal resistance of susceptible species. This is when hypersensitive response is triggered.

- Hypersensitive response /HR:
  - It is more targeted (specialized) than basal resistance.
  - It induces necrosis of the cells around the area of infection that leads to the isolation of the pathogen from the surrounding healthy tissue.
  - There is also a gradual build-up of toxic substances and antimicrobial agents (phenols, phytoalexins) that help to restrain infection.
- Additional mechanisms:
  - Roots produce substances that attract useful bacteria.

- Some plants produce substances which attract beneficial insects (mostly larvae).
- Other plants have developed a symbiotic relationship with insects that directly attack any "intruder".
- In cases of viral infections, apart from the hypersensitive response, certain RNA-silencing mechanisms are also triggered.

- Systemic acquired resistance /SAR:
  - It includes defence mechanisms that are present in parts of the plant that have not been infected yet. As a result, the plant acquires immunity to a wide range of pathogens for a period which varies between species.
  - It requires the presence of salicylic acid, which is produced during the hypersensitive response.
  - Some plants produce methyl salicylate that is transferred to other parts of the same plant or other neighbouring plants by air, and it acts by stimulating immune reaction.
  - Jasmonic acid is produced at the site of infection and it moves through the phloem to the rest of the plant, where it induces the synthesis of substances with antimicrobial properties.

7.3 Other methods and means of treating plant diseases in organic farming systems

7.3.1 Hygiene - Quarantine

It is obvious that we have no disease if the pathogen does not come into contact with the plant.

In an area where there is no disease, the introduction of the pathogen is likely to cause outbreak of disease. This is due to the non-development of resistant plant biotypes in the presence of a pathogen. With the method of quarantine the occurrence of a devastating disease that exists elsewhere is excluded. Quarantine measures include ban of import of vegetable products, propagating material, soil and any other material that is likely to contain pathogenic contaminants. Specific controllers, inspect imported goods at the customs of the country. Therefore, the occurrence of a devastating blight can be avoided in a certain country. A classic example is the actions taken in the UK to prevent entry of “Synchytrium endobioticum” into the country. This pathogen exists in continental Europe. A particular variety of potato (King Edward) that is grown in Britain and is highly appreciated for its organoleptic characteristics, is highly susceptible to Synchytrium endobioticum. Due to quarantine measures taken by the United Kingdom, this potato variety is still being cultivated in the country.

Another way of reduce disease development is taking hygienic measures. These are especially important on controlled crops such as greenhouses. All practices designed to reduce the number of contaminants and their distribution, are considered to be the greenhouse hygiene. Destruction of 90% of contaminants has been calculated that corresponds to the reduction of the disease from 62% to 9.2%. The sources of contaminants must be identified and destroyed in the space surrounding a greenhouse. These include:

- bins,
- corridors,
- weeds within 10 meters of the greenhouse,
- perennial vegetables and flowers,
- open water containers,
- other water reservoirs, etc.

Since clothing can be contaminated with vegetable juices, is also a source of transmission of viruses and bacteria and should be washed regularly. Tools have to be cleaned and sanitized, while workers should wash their hands regularly during the working process. Persons who do not perform any kind of work should not be inside the greenhouse as they might transfer pathogens on them.

7.3.2 Growing Media

These measures are primarily designed to modify the environment of the plants at the expense of the pathogen growth. These can be direct farming measures or modification of the application time of field work.

7.3.2.1 Ventilation

As the majority of plant diseases is manifested in high humidity, ventilation of plants plays a great role against pathogens. Ventilation of plants may be achieved either by diluting the foliage or by increasing the distance between the plants. A classic example is the defoliation of vines until the knot where the first bunch of grapes is developed, as a measure to avoid Botrytis. Increasing the distance between the plants has not only beneficial effects in reducing the humidity of the environment but it also helps in matters of temperature and lighting, which are critical factors in the evolution of infectious diseases.

7.3.2.2 Change of sowing time

Sowing time affects plant diseases because it facilitates the plants to reach the stage of their top resistance at a certain point of time when a pathogen is about to occur. Therefore, the attack of the

pathogen does not coincide with the vulnerable stage of the plant. In the case of wheat common bunt (Tilletia tritici) a later sowing in autumn means that the sensitive stage of wheat development does not coincide with the time that the pathogen is more aggressive.

7.3.2.3 Soil treatment

Plant protection effects of soil treatment are:

- Prevention of contact between contaminants and plant roots
- Destruction of intermediate vectors of plant pathogens

The latter is achieved by destroying weeds, since chemical weed control is not allowed in organic farming. For example, the destruction of lambsquarters (Chenopodium album) in beet crops by treating the soil is an important measure to avoid rhizomania, since the pathogenic virus is transmitted by lambsquarters. Similarly, the destruction of berberis, which is the intermediate vector of black rust of wheat, interrupts the life cycle of the pathogen (Puccinia graminis).

7.3.2.4 Crop rotation

Refers to the interruption of plant growing in a field, while cultivating the soil in order to destroy native vegetation. It is applied mainly to herbaceous and arboreal plants for the treatment of soil-borne pathogens, nematodes and soil insects. Monoculture leads to development of pathogenic populations and increase of intensity of the diseases they cause. After a certain time period the soil is heavily contaminated and unsuitable for the particular plant crop or related species. With a 3-4 year crop rotation, the creation of this situation is avoided. Namely, we avoid growing the same plant or plants belonging to the same botanical family for 3-4 years. Soil-borne pathogens, whose contaminants remain in vegetable residues and are preserved only through these residues, are dealt with crop rotation. In contrast, pathogens that form long-standing perpetuation organs (e.g. sclerotia or chlamydospores) cannot be eliminated by crop rotation. However, their population and the importance of the disease they cause can be reduced though crop rotation. For example, a crop rotation of 3-4 years reduces hydromycosis that is caused by fungus Verticillium dahliae, which forms mikrosklirotia that remain on the ground for more than 10 years.

7.3.2.5 Fallows

This term denotes the act of plowing land and leaving it unseeded. The field is left, as is commonly said, to “rest”. During the fallow pathogenic contaminants are destroyed to a large extent by soil microorganisms. Especially when fallow is followed by a hot summer the effect is greater. Phytopathogenic fungi and nematodes are treated with fallow.

7.3.3 Natural Media

7.3.3.1 Sterilization - Pasteurization of soil

Sterilization is a technique that aims to eliminate contamination. In the case of a long-standing monoculture in a greenhouse, soil pathogens increase and therefore should be reduced by partial or complete soil sterilization at levels that do not cause problems. Complete soil sterilization with steam or dry heat is extremely expensive and often causes problems by increasing manganese and ammonia to phytotoxic levels. On the other hand, the majority of soil disinfectants does not

effectively control bacteria. Soil steam sterilization (soil steaming) is the accepted method of soil sterilization in organic agriculture.

Microorganisms are more vulnerable to steam when they are in an active metabolic stage, but many of them form resistant structures (sclerotia, chlamydospores, oospores, etc.). The latter are more sensitive when the resistant stages are wet and warm. The most appropriate time for soil sterilization is immediately after harvest and, in fact, it is recommended to collect the crop residue before sterilization. In addition, soil should not be compact.

A temperature of 82º C for 30 minutes it is considered to sterilize soil. Most pathogens are killed at 70º C.

Soil steam sterilization is mostly implemented in greenhouses, as it is not possible to use this process in an extended field area.

Three main methods of application of soil steaming are:

• Covering the ground with plastic and distributing the steam through piping and nozzles at the soil surface (up to 20 cm) for 6-8 hours.

• Distributing the steam into existing drainage pipes for soil sterilization in a depth up to 60 cm.
• Applying negative pressure, where pumps at soil surface pump the steam distributed through piping located at a depth of 60 cm and a distance of 3 m between the conductors. However, extra soil or composts can be sterilized in special containers.

It should be noted that soil steam sterilization causes the so-called "biological vacuum". This means that not only pathogens but saprophytic organisms, many of which are antagonists of pathogens, are destroyed as well. It is thus observed that after sterilization the soil is colonized by pathogens easier and, as a result of this, after a period of 2-3 years the soil is actually more contaminated than before the sterilization, since pathogens grow without competition. Another disadvantage of steam sterilization at a temperature over 80º C is the development of manganese toxicity, especially in acidic soils and for 60 days after sterilization. Finally, the method of sterilization is quite costly. Less expensive is the pasteurization of soil in which the soil is heated to about 80º C with a mixture of air and steam. Through this method most pathogens are destroyed, while the thermostable microflora, which exerts a significant biological control on other pathogens, is not affected.

7.3.3.2 Solarization

Solarization is a promising method of soil sterilization. It refers to the coverage of the soil with a dark-colored plastic, during the summer season, and after the field has been cultivated and watered. Soil remains covered for 6-8 weeks. Therefore, the steam generated under the plastic has a microbicidal activity. The incorporation of organic fertilizer (manure or organic additive) in soil treatment before placing the plastic, it is possible to reduce the time of solarization in 4 weeks. A double layer of plastic separated by PVC pipes per 2-4 m, so that there is an air layer of a thickness of 5-10 cm between the layers of plastic, increases the effectiveness of solarization. In Greece it is proved that solarization for 4-6 weeks during the summer reduces effectively fungal hydro mycosis of cucurbits, such as Fusarium oxysporum f.sp. cucumerinum, Foxysporum f.sp. melonis and Verticillium dahlia. This method was equally effective in reducing the V. dahliae, Pyrenocheta lycopersici and Clavibacter michiganensis subsp. Michiganensis in tomatoes and artichokes. The use of impermeable plastic sheets in combination with the application of the competitive bacterium Paenibacillus sp. reduced the time of solarization against Fusarium oxysporum f.sp. radicis lycopersici in 15 to 20 days instead of 4 weeks. The method of solarization proved satisfactory for sterilizing soil of greenhouses in many Mediterranean countries as well as in Japan, Belgium etc. By

this method, besides sterilizing greenhouse soil, soil or sand for substrates in containers (pots) can also be pasteurized. A simple technique applied in Florida, USA is as follows: the substrate to be pasteurized is placed in garbage bags, which are then placed in other transparent plastic bags. Subsequently, the double closed bags with the substrate are placed outdoors usually on paved floor or covered with cement, where they are exposed directly to the sun. After solarization the substrate is distributed in layers of 10 cm in pots or other containers for plant growth.

The solarization can be an inexpensive way to reduce contaminants, but it should be kept in mind that the soil or other substrates to which this method is applied, have to stay out of productive use for several weeks.

7.3.3.3 Thermotherapy

By thermotherapy is often possible to disinfect the plant material (seeds, cuttings and whole plants). By applying temperature, which is below the lethal for plants limit, for a period of several minutes to seeds, and for a period of several days or weeks into whole plants, it is possible to eliminate viruses.

8. Module Summary

The main outcomes of this section are the following:

- Knowledge of the main types of nurseries
- Knowledge of field and container nursery production, as well as greenhouse production and production through hydroponics
- Knowledge of plant diseases (Fungi, Oomycetes, Bacteria)
- Knowledge of plant disease management and plant defense mechanisms

Learning Outcomes:

Chapter 2:
- Types of plant nurseries

Chapter 3:
- Field and container nursery production

Chapter 4:
- Knowledge of processes, products, outcomes and equipment of greenhouses

Chapter 5:
- Knowledge of procedures and philosophy of hydroponics

Chapter 6:
- The various kinds of plant diseases, their characteristics and how they are classified

Chapter 7:
- Plant disease management and plant defense mechanisms

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CHAPTER 4: DIRECT SALE OF PLANTS AND TURF

1. Introduction

Sales are the most vital part of a successful business, as new customers are brought in and the cash flow rises, which are both very important aspects for the operating system. The Vendor is a mostly important member of the company, since it is they who are in charge of creating and keeping contacts within the marketplace. In a very straightforward way they are the ones ‘providing’ for the rest of the company.

The main objective of this section is for participants, having completed their training, to gain proper knowledge on:

5. The basic definitions of sales
6. Some general rules of sales
7. Some simple sales techniques regarding the different stages of sales

2. Introductory Definitions

The main objective of sales management is the development of those activities designed to attract and persuade consumers to buy the company's products. This way, the value of the product or service is converted into money which flows into the business to improve its financial position and eventually be invested for various activities.

The product reaches consumers directly or indirectly. Thus, direct selling is that under which the consumer purchases the product directly from the producer. Indirect sale is one made with the help of intermediaries such as wholesalers, retailers, dealers, commission agents.

In each business there is a sales department. The management of the sales department accounts for, among others, planning and organizing sales and coordinating the actions of sellers.

The sales plan of a business is planned, created, operated and developed in cooperation with other branches within the business, ie marketing, production, finance, etc. It is determined by the general strategic directions of the company and it aims to pursuit the general objectives.

Cooperation exists with the following departments:

- Production on quality and quantity of products
- Storage for product adequacy issues and packaging materials
- Finance, to monitro the financial situation of the business.
- HR, for the development of human resources.

In any organization, either a business that provides products or services, ora non-profit organization, the administrative sales process focuses on three main stages:

- Planning, including establishing objectives, generating ways for achieving them, and determining the required number of sellers.
- Implementing the program, which includes organizing and staffing of the business, and the realization of the various functions according to the original design.
- Evaluating the program, by examining whether the final result is in agreement with the original planning (sales analysis, cost analysis, evaluation of sellers performance). The evaluation helps to establish future objectives strategic planning.

3. General Advices

Below, there is an extensive reference to the art of effective customer service. The necessity of implementing quality customer service was delivered greatly by the creator of the concept of ‘total quality management’, Edward Deming, who had once stated: "Learning is not compulsory, neither is survival!". In fact people need to realize that:

1. They represent their company, when dealing with customers.

2. If these people continue to be their customers the company will make another step towards safeguarding its existence

How can efficient customer service be provided; The following tips might help clear this out:

- Pay attention to personal appearance: Dress up in a successful style.

- Notice the appearance of the workplace: If put in the shows of a customer, would this environment be sufficient and attractive? If the answer to this question is negative then it would have to be reconsidered, in order to fit in to the actual sense that the customer would want to feel. After all, the customer always wants to get a good vibe.

For example, wooden carved furniture and brown leather sofas within a law firm office would reflect perfectly the validity of that person, as so would a fuxia painted wall in an advertising company which would aim to reflect on the creativity of its personel.

- Make sure the reception area is well preserved: Be aware of certain aspects such as the cleanliness of the area, proper lighting and noise levels, sufficient number of sears, as well as the presence of promotional and informational materials.

- Greet and refer to customers by their names: There is simply no better word to be heard than one's own name.

- Always say 'please' and 'thank you': Simple, yet wonderful words. Consider how rarely they are being heard today and how only few people actually mean that when they say it. Just become one of them.

- Create 'user groups': Create a community (such as the company's site) where customers could exchange ideas and views regarding the use of the company's products. Global giants do that, as everyone else should.

- Use ‘focus groups’: Gather all the ‘important’ clients for a specific company meeting, in which all the higher management of the company will attend to, in order to specifically thank the customers for their choosing and for putting their faith into the company.

Also, the customers need to be asked for their feedback on the company’s policies and services, in a straightforward way of expanding further and becoming even better.

- Keep regular contact: Ask the customers how they are doind, and whether they have any queries regarding the use of the product, if they had encountered any problems during operating, if any upgrades, additions, or even adjustments are needed. Be aware of the attitude – it should only be a call that intents to show pure interest and nothing more. By keeping close to the customer after the sale has taken place, there is an extra added value.

- Ask for references: No one should be afraid of doing so, even though there are plenty who actually do. Only the top dare.What someone should do is to look at feedback and references as the as the natural positive consequence of an excellent service from the company towards the client. The customer who appreciates will most certainly be willing to

provide a referal. All that has to be done is to politely ask if that customer has any friends or relatives that they might be further interested in the company's services.

- Keep a record of negative events: What are the most common problems customers are facing? What do they usually dislike mostly and which are the most common complaints and issues? Why are misunderstandings taking place? After these topics are adressed a correction plan should be drawn.

- Provide explanations : When talking to the customer about the product and its operation, simple language and plain words should be used, to avoid any misunderstandings. Too specific or technical terms may mislead the customer. When explaining, make sure the customer clearly understands and both are parties are on the same page. If the customers does not know exactly what to look or ask for, guide them along with specific questions, in order to clarify things as adequately as possible.

- Make customers a top priority: As soon as a person walks through the entrance door, leave aside any other actions that are not important and place all focus on the customer. When interacting with the customer, there should be no interruptions at all, from colleagues or phone calls.

- Explain what you can do for the customer: Always begin by using the phrase ‘How may I help you’. If a question cannot be answered directly, no pulling back or impovising should take place. Instead, simply admit it by stating ‘I am not so sure about this but I can find out immediately and let you know’.

- Find out why customers get upset: The most common reasons for jittery include slow or bad service, the person who provided the service been rude, indefferent, or unaware of the subject, the product not reaching the customer’s expectations, the customer being send from one advisor to another, without being served, or even the customer receiving conflicting information about a product from two or more employees of the company. The staff should all be aware of these aspects and create a correction plan with them.

- Provide annoyed customers what they ask for: Simple and sincere actions can regain their confidence. What customers really want are to be heard, taken seriously, treated with respect, receive immediate assistance, be understood when explaining their problem and finally, be reassured that any error or mistake that occured won’t happen again in the future.

- Avoid doing the following: Never promise something that cannot be implemented (faster service than possible), tell the client the problem is not your fault, or explain that you cannot do anything for them. It is better to focus on something to assist the customer with.

- Give emphasis on body language: Recognize the signs trasmitted with nonverbal communication by the customer, while at the same time ‘check’ your own.

- Educate the staff: People working on the ‘first line’ should be fully aware of the company’s services, policies, and service prodecures followed. In a more personal level, they need to be fully aware of their own personal competences and responsibilities.

- Exceed customer expectations: For example, if goods can be delievered within 5 days, let the customers know that they will be delivered in 6 days, and then pleasantly surprise them.

- Convert objection to question: Use the ‘so... I understand’ method. For example, when a customer says ‘ you all say the same things...’ the proper answer should be ‘so if I understand correctly, you would like to hear things by their name...’.

- Reward outstanding performances: Provide incentives to the staff.

4. The 35 Simple Sales Techniques

4.1 Get ready for the sale

Five techniques that refer to excellent preparation for a sale

1. During a sale, 55% of the transaction is happening through the body. So what can be done for this; a great start would be to buy a good book on body language and one on manners and study them thoroughly. Humans are still just another species of animals, which is something we tend to forget, especially now when living in cities. People learn to respect extraverbal communication. Mostly proposed, is moving the upper body ends, which provides flexibility, and avoiding close movements that ‘tie’ the upper and lower ends and prevent the essential part of natural communication. It is also suggested to avoid gestures and hand movements close to the face, as well as handshakes.
2. Keeping the 55% body movement in mind, errors should be identified. Such errors include the hair, glasses, breath, armpits, clothing, shoes, tie, shirt, accessories, handbag, nails, and basically all sorts of types. Therefore, when looking for mistakes, they cannot be found

everywhere. For hair, regular haircuts are recommended. Vision glasses should always be clean. Fresh breath should be maintained at any point, by chewing a gum or doing a mouthwash. For underarms, there should be constant monitoring of the area, and when necessary, aids such as roll-ons can be used. For the clothing part, it should be assessed according to the customer's expectations. Cleanliness and freshness must always be key parts.

3. How the voice sounds is very important (it is 38% of the subliminal message for the sale). The first aiding tool during a sale is the voice. It is directly linked to the personality of the person who speaks and reveals elements associated with the cultural, social and professional aspects. The dimensions of the voice are: volume, tone, quality, timbre, melody, intonation, speed and pronunciation - articulation. In order to use these dimensions the full awareness of the voice as a sales tool is required, as well as the concentration of the seller to the customer's replies. The client is entitled to say whatever they want. However, it is known that choices are reduced from infinite to specific. These particular choices - reactions of the client must be known to the seller. In any case use the voice to create a sale. The voice cannot help in these

situations if unawareness exists. Used properly and wisely, it can be a mostly valuable selling tool.

4. Realizing that within the preparation falls the persistence of selling and do not talking for at least eight hours (the words account for 7% of the sale message). To come to this realization, distinguishing the colors red - green - blue and their connection with some spectra for hour sales activity is very helpful.

Red: Creating an inventory

Green: Creativity - Ideas.

Blue: Rating – action. Sale, sowing – reaping

Sales organization. Priorities – assessments

07:00 – 09:00 Read (indication)

09:00 – 17:00 Blue (indication)

17:00 – 21:00 Green (indication)

Green

This is the code for the unknown, the future action that has not yet taken place, the possibilities that can be realized or not. When operating with green, there is not action but mostly use of the brain for ibrainstorming, which may or may not be used. All new ideas are springing from a green mindset. This is a multidimensional way of thinking, not necessarily following a specific direction, using imagination and accepting intuition. It is thought that it does not follow conventions, subverts the established and likes to gamble with the possibilities. The Green way of thinking does not fit with the mainstream, as it seeks to create something where there is yet nothing.

For this reason precisely it is likely that this kind of thinking may become annoying, lead to early action taking, be misunderstood and oppressed. On the other hand, Green is the color of fun and a source of creativity.

Red

The color of truth, of what is already known and has already happened. The way of thinking that seeks and finds information about the world, people and things. It collects data and information and organizes them in a logical manner. It stimulates circulation and comprehension / composition of different perceptions of reality, which, even if inaccurate, they are necessary in reaching the truth. Red is the color of communication. It embodies our desire to be closer to other people, to understand each other and cooperate by exchanging information of all kinds.

Blue

Associates with judgement and decision. The Blue thinking makes choices, and express opinions about things. When operating in Blue, there is choosing between information, and decision on what is relevant in forming configurations. It is about making a decision that will guide the actions. Blue is the color of convergence and directs towards a specific course, to go on in making a decision. With Blue there is action and results. Blue uses the Green and Red, recruited for the benefit of the

purposes of specifying the kind of ideas and information relating to the decision which is imminent. Blue is what takes all the facts into account and directs energy.

5. Within preparation falls respect, respect for the art and technique of sowing and mowing. A good salesperson is a good farmer. Saddened much when there is a day in which there has not been much sowing. When there are few seeds, the resulting slack occurs after two months, three months, a little earlier or a little later. Above all, there should be respect for passing the message to the customer, which occrus through: 55% body, 38% voice and 7% words. The message is a flawless – emotionally and technically- cooperation.

4.2 Sales Approaches

Five techniques for a simple approach of the customer. Adequate approach = more sales

1. Integrity is important for an approach. At this stage, the seller must remember that punctuality when attending an arranged appointment, will most usually bring money in. The good relations that the seller should keep with all his is appointed to meet also brings money in. Politeness and good manners as well.

2. Respect the powerful customer. It is one who says something and immediately demands for production. Talk briskly to them, asnwer briskly to them. Use their main motive, which is nothing else but time. Make it clear that there will not be any time wasted.
3. Respect the popular customer. The one who expresses themselves spontaneously and quickly wants to gain recognition for their uniqueness. Talk descriptively to them, by using various stories. Answer in the same manner. Use their main motive, which is nothing else but recognition and reputation. Make it clear that there will be no time wasted, just plain fun along the way.
4. Respect the peaceful customer. In this case, the one who simple does not say much and most importantly does not want changes. Talk to them in a preservative manner. Answer with references from the past. Use their main motive, which is steadiness, no change. Make it clear that there will not be any nasty surprises and all the propositions and suggestions will fall among the same guidelines.

5. Respect the perfect customer. Again, the one who does not say much but instead is asking for proof for most things. Talk from experience. Answer with numbers, certifications, receipts, documents. Use their motive, which is plain perfection. Make it clear that there will be professionalism all the way from start to end, and that the perfectionist way of thinking is mostly respected.

4.3 Sell to all customers or only those who you look like?

Five techniques for obtaining the vital information needed without procrastinating and wasting time.

1. Ask about all the things that should be known. By asking comes the learning, of what really allows the sale to proceed, or what holds the sale back and prevents it from happening. It should become clear that making questions is not always about quality but also quantity. There is not need to justify for asking questions, it is a right which has to be firmly used.

2. Always maintain a relaxed and open attitude on all issues that two people can talk about, whether inside or outside the professional circle. The goal is not to wonder around all over the market to defend personal beliefs and views, but to sell more. In general, it is wise to start a conversation and expect that others might disagree wand that different opinions might be presented. In the meantime, there is no reason as to why a strong relationship should not be formed between the two parties.
3. Always try to at least be informed about the place, time, and content of training events. In the same frame of mind keep being informed about professional book releases as well as maybe buying some of those.
4. In now way it is justified a seller to accuse a colleague, competing products, or companies. Violation of this rule may result in malfunctioning and eventually the deportation of the vendor from many markets. Even when finding out that someone is spreading bad words towards another, do not retaliate. This tactic is based upon the idea that however one may hurt another, this person will eventually become stronger.

5. Continuously ask questions with a positive spirit. In sales, as in life, there is one basic rule which is no other than the law of sowing and reaping. It means exactly what it says, you get what you give. Of course, it could not be faulty in the way sellers interact with customers. This law can function in three ways: a) Operates negatively, meaning that f trouble is created, more trouble will occur; b) Operates positively, meaning that if help is given, help will be returned; c) operates neutraly, meaning that if no sowing takes place, there will be no reaping. By law, it is understandable why certain salespeople don't progress with their sales career. This negative otucome is due to the fact that they don't know the triple dynamics of the law of sowing and reaping.

4.4 Did you plan your presentation? Had made it clear in advance what you want to sell?

Five techniques on how to present only what interests the customer with no time wasted

1. Excellent product knowledge, which can work towards the benefir of the customer.
2. Self discipline and few words. Loads can be presented, only a few should. The customer should be introduced only to what could be of their interest, during a given preiod.
3. Gradually expose material, without any kind of style and without lying.
4. Everything can and must be sold during a presentation, and most importantly, the length of the presentation should be defined in advance. If the person across the room is the only one to receive the information and create the discussion with, then the presentation could last for quite a while. If on the other hand that person is not fully in charge of taking responsibility, the presentation could be of lesser length, and during the next presentation where all the members would be present, more details could be discussed with further detail.

5. The secret is to do as much presentations as possible. Look for customers everywhere.

4.5 Do have tools to successfully confront each objection?

Five simple techniques for adressing objections. Objections require systematic responses, and not improvisation or inspiration.

1. Always have in mind a strong selling point for the product that is about to be presented, without asking for someone to help you out with this. It should be a strong point that even the most had to convince customer would not be able to doubt or challenge. If there is an objection, pay close attention, and regardless of its content, play the cards right and confront it with caution. Be aware of the response given and detect if answered satisfactorily. If so, proceed to the closing statement. If not, proceed to the ΚΕΑΠ (Κατανόηση, Επιβεβαίωση, Ανοικτή Πρόσκληση)» που αντιμετωπίζει ως δεύτερο κύμα τις αντιρρήσεις των πελατών.
2. Χρησιμοποιήστε ως δεύτερο κύμα αντιμετώπισης των αντιρρήσεων, το «γενικό πλαισίωμα απάντηση ΚΕΑΠ». Δηλαδή, ακούστε με προσοχή τον πελάτη, κατανοήστε όσα ισχυρίζεται, αναφερθείτε σε άλλους που ισχυρίζονταν τα ίδια και τώρα είναι σταθεροί σας πελάτες και,

τέλος, προσκαλέστε ανοιχτά τον υποψήφιο πελάτη να σας εμπιστευτεί και να ξεκινήσει συνεργασία μαζί σας.

3. Allow the customer to talk about the market crisis. Agree with them, shortly, by using successively positive answers. Avoind heating up the debate and creating further discussion, based on the market crisis. Well0being is evident in many aspects of a person's life and that is something no one should forget. That should be the basis when referring to the crisis. The power of now should always be utilized when contacting customers.
4. It should be stated clearly that there are available times for meetings with customers throughout each day, in order to meet their needs and create a good partnership. A sentence should be formulated with the following word order: 'There is availability throughout the day for anything needed'. This proposal should be supported with a warm and welcoming voice, positive body langauge, and great excitement.
5. Price should not matter. A good value between quality and price is all that is needed for profitable sales, and not the best price in the market. There should be no insecurity regarding the price, unless consistency, efficient service and expertise on the subject are missing. If these values are missing, then there might be a problem, which no price adjustment or

discount would solve. Value in price should be combined with the general truth, which is none other than ‘whatever exists will become scarce’,

4.6 Do you close the business or get promises?

Five techniques for permanent closure; Either sell, or move on to the next customer.

1. The very first ‘no’ should be defiantly ignored. Behave like nothing happened, aiming to sell despite any negative attitudes from the customer. Only this way will a negative reply turn into a positive one. It will be very surprising.
2. Win-win logic should always be kept in mind. Never avoid customers or discard them even if this can be done. Finalising the sale always aims at two goals: direct sales and good relationships with customers. It goes without question that if this mentality is not kept, then a strong relationship will easily break down. ‘The seller wins, buyer loses’ is a way of thinking that should be avoided at all times. Even if customers don’t appreciate positive attitudes towards them, it should not bring despair, or the thought of quitting. It is actually a fact that this

‘win-win’ attitude does not immediately bring positive outcomes, but works best in long term occasions.

3. Service packages, good relations, and good quality of products, should always be displayed. Emphasis should be given to those elements that are difficult to be replicated within a competitive market. Having good quality products and impeccable procedures is never sufficient enough, since those attributes might be offered by competitors. The target point should be human relations (combined with the attributes mentioned above), since those who make good use of this practice will prevail in the competitive market.

4. There should be no hesitation in finalising a deal immediately, especially when dealing with a very promising customer. Immediately closing the deal, means everything has been done correctly and that the selling can go on as standard. It might feel a bit difficult to do, and therefore gradual adoptation is recommended. A direct deal, with a customer provides a dynamic which reverses provisional sales that might be heading in the wrong direction.This technique should be adopted even when all indications are leaning towards not getting the job. Surprisingly enough, the potential customer will eventually succumb to the invitation and a partnership will be formed.

5. It is essential to be emotionally balanced at all times and to not postpone any possible sales. The customer should be able to account for their responsibilities, as customers often believe that not making a decision is more preferable, and they settle to it. This of course should not be the case and both the seller and customer must be aiming for a quick transaction. When this eventually occers, it will definitely be a proper one.

4.7 Do you serve pervasive?

Five techniques for getting into the customer's mentality and affect their way of thinking:

1. Customer service means expanding customers. The end of the good guy – the start of a useful partnership. Well-developed partnerships means less trouble for customer service. Multidimensional relationships should be developed, with customers being the target area.
2. Aim for a 'super' service, when provided.
3. In any successful customer service, resell by adding codes.
4. There is no reason for satisfying already satisfied customers. Time and resources shoud be spent on new and active customers.
5. A low profile should always be kept. Never act like a judge. There is no reason for diving the market between right and wrong, but should be aiming receive and create positive emotions.

The passage above was extracted from Chapter 2 of the book "The Lean Way in Sales, 405 Sales approaches" (A' Edition May 2010).

5. Module Summary

The main outcomes of this section are the following:

- Knowledge of the basic definitions of sales
- Short but important advices and tips on sales matters
- Knowledge of preparation procedures, approach, plan, difficulties and ways of addressing them.

Learning Outcomes:

Chapter 2:

- Introductory definitions of sales

Chapter 3:

- General advices on sales matters

Chapter 4:

- Knowledge of preparation procedures for a sale
- Ways of approaching the sale
- Selling to all customer groups or only to those alike
- Presentation design and plan
- Ways of facing objection
- Closing the deal
- Serving pervasively

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SECTION 5: GARDENING

1. Introduction

The main objective of this section is for participants, having completed their training, to gain proper knowledge on:

8. General facts about the history and definition of gardening
9. The main types of gardening
10. Basic gardening techniques
11. Possible traps and ways to solve/avoid them

2. Definition – Background – Types

2.1. Definition

Gardening is the practice of growing plants, as part of holticulture. In gardens, ornamental plants are usually grown for their flower, foilage, or overall appearance. Useful plants, such as root vegetables, leafy vegetables, fruits, and herbs, are usually grown for consumption, to be used as colorants, or for medicinal and cosmetic use. A gardener is someone who practices gardening, either professionaly or as a hobby.

Gardening has different scale ranges, from fruit producing trees to large plantations with one or more different species of trees, from shrubs to herbacious trees. Furthermore, gardening may refer to plants grown in residential yards, including lawn, or even plants grown in in small or large containers, indoors or outdoors. Gardening may be very specialized, with only one crop plant species, or account for a large number of different plants in mixed plantings.
It is an active participation in the development of plants, and tends to be of intenstive labor, which differentiates it from farming or forestry.

2.2. Background

Forest gardening, a food production system based on plants, is the oldest form of gardening all over the world. Forest gardens originate from prehistoric times, over riverbanks, jungles, and wetlands on the foothills of monsoons. Over the gradual process of improving the family circle, useful species of tres and vines were discovered, protected and imporved, while unwanted species were extinct. Eventually, allien species were also selected and embodied the gardens.

After the emergence of the first civilizations, wealthy individuals began to create gardens for purely aesthetic reasons. Egyptian tomb paintings from around 1500 BC provide some of the first physical evidence hornamental horticulture and landscape design, which depict lotus and ponds surrounded by symmetrical rows of acacias and palm trees.Ornamental gardens were mostly famous during ancient times, with the most famous example being the Hanging Gardens of Babylon. In ancient Rome there was also a plethora of gardens. The Hanging Gardens of Babylon are a World Heritage Site, and one of the Seven Wonders of the Ancient World. Also, another well-known site were the Islamic gardens, as well as the European gardens of the 13th century, famous for both their beauty and utility.

The gardens of the 16th and 17th century were symmetric, with balanced proportions and a more classic look. The gardens of Renaissance were adorned with sculptures and fountains, and Europeans began to plant new flowers, such as tulips, marigols, and sunflowers. In the 18th century, gardens remained a privilege of the upper class. By the next century, gardens were also available to the middle class too.

2.3. Types of gardening

Residential gardening takes place near the house premises, in an area referred to as a garden, typically located on land and near the residence. It may also be located on a roof, a balcony, a box by the window, a patio, or even in a viviarium. Gardening is also practiced in non-residencial green areas, such as parks, public or partly public gardens (botanical or zoological gardens), or even amusement parks, along transportation corridors and around tourist attractions or hotel gardens. In these cases, a group of gardeners or maintenance people preserve these gardens.

- **Indoor Gardening** is concerned with indoors growing plants, within a residence, a building, or more professionaly in a greenhouse. Indoor garderns are sometimes equipped with their own heatint and air-conditioning systems.

- **Native plant gardening** is concerned with the use of native plants with or without the intention of creating a wildlife habitat. The goal is for a garden to be created with harmony, and to adapt to a given area. This type of gardening tupically reduces water usage, maintenance, and fertilization costs, while increasing interest in native flora.

- **Water gardening** is concerned with gowing plants adapted to pools and ponds. Bog garderns are also included in water gardening. All of these require special conditions and considerations. A simple water garden may only consist of a tube containing the water and plants. In aquascaping, a garden is created within an aquarium tank.

- **Container gardening** is concerned with growing plants in any type of container, either indoors or outdoors. Common containers are pots, hanging baskets, and planters. Container gardening is usually used in atriums, on balconies, terraces, and roofs.

- **Hügelkultur** is concerned with growing plants on piles of rotting wood, as a form of raised bed gardening. Translated in English, it means ‘mound gardern’. Toby Hemenway, noted Permaculture author, considers wood buried in trenches to also be a form of hungelkultur, referred to as a dead wood swale. It is a technique practiced by Sepp Holzer as a method of

forest gardening and agroforestry, and by Geoff Lawton as a method of dryland farming and desert greening. When used as a method of disposing large quantities of wood waste and residues, this method accomplishes carbon sequestration. It is also a form of xeriscapping.

- **Community gardening** is a social activity in which an area of land is used for gardening by a group of people. It provides access to fresh produce and plants, as well as provides satisfying labor, neighborhood improvement, sense of community, and connection to the environment. Community garderns are usually owned in trust by local governments or nonprofit organizations.

3. Basic Techniques

3.1 Preparation

For a proper preparation the following points should be taken into consideration:

- Anything that may exist in the planting point
- Direct sunlight or shade
- Windy spot
- How cold will it be over the winter, and how warm over the summer
- How rainy could it get
- Year-long supply of water
- What is aimed; Hide from the neighbor – cover an adjacent wall – highlight some features of the garden
- Spare time
- Money to be spent

After these issues are adressed, a visit should be paid to the nearest garden center for purchasing all the necessities.

What needs to be bought?

If dealing with gardening for the very first time, proper equipment is essential. What is mostly important, a pair of gardening gloves, a shovel, and prunning shears. If planting on a balcony, some pots will be needed. Pots can be acquired from the market, varying in size, material, and shape. Appropriate soil will be needed for the pots, in a quantity proportional to the number of pots.

In garden centers, soils of different textures can be found, suitable for all types of plants. The staff on duty should be more than able to help in choosing the proper plants and answering any relevant questions. The proper plant will therefore be placed in a proper position, according to the weather conditions surrounding the area, as well as the decorative needs.

Retrurning back home

Now that all the necessary material have been acquired, the planting, either in the garden or the balcony, can go ahead. The plants should be placed in the exact desired positions for a more accurate outcome. Any possible changes on the combinations of plants should be adressed before the planting beginns.

3.2 How to plant

The planting process is simple enough, as long as it is done with caution:

- After deciding the point of planting, a hole with a diameter similar to that of the plant's root ball must be digged.
- If the soil is not of good enough quality, compost can be added to the bottom of the hole.
- The root ball is removed from the pot and placed in the hole.

- The hole must be filled with soil and lightly pressed, so the root ball makes good contanct with the soil.
- The new plant should be watered, and stakes can be used if necessary. The stakes must be tied loosely to the trunk and not dig into the bark or tighten around the tree.

<u>If the plant is placed in a pot, the procedure is even simpler:</u>

- Some broken tiles or small stones should be placed to the bottom of the pot, to keep the holes open for water to run through.
- Some soil must be placed.
- The plastic pot from the plant is removed and placed to the pot in use.
- Soil should be added for filling the gaps and covering the root ball of the plant.
- Lightly press and then water.

3.3 Taking care of plants

Once decided where the plants are to be placed, they should be watched over continuously and attended to their every need. Among others, taking care of plants refers to watering, delving, removing weeds from the soil, adding fertilizer, and pruning occasionally.

How often should plants be watered

Each plan has their own needs. Depending on the season, temperature, position of each plant, each one needs the appropriate amount of water. Each species also has different watering needs. Cacti and succulent plants need very little water, while other species require a larger amount of water. Also, the soil plays its part in maintaining water, and can further assist in creating a proper watering schedule.

How should plants be watered

Water should reach the plant gently around the roots. Watering length may vary, depending on the plants' need for water. Water draining is also very important, as excessive accumulation of water may rot the roots of the plant. There should be no stagnant water. Furthermore, watering should be done during a time of the time when the plant will use all of the water provided. Thus, periods of high temperatures or strong winds should be avoided.

How often should plants be watered

During warmer months, watering should be frequent, as the plant has to cope with high temperatures and lack of moisture. It is advisable to sprinkle the leaves in order to cool the plant. On the other hand, during winter months, watering should occur less frequently. The strong and icy winter wind may also cause water issues.

When should fertilizer be used

The frequency of fertilizations is determined by the plant species, the stage of development, the season, and the gardener's desire for lavish foliage or flowering. The main fertilization occurs during the end of winter, while the complementary while the plant is blooming. Complementary fertilization should take place every about two months, except during summer months. Fertilization instructions should always be followed, in order to prevent any issues with the plants.

Pruning plants

Pruning is done to remove unnecessary branches in order to revitalize the plant and to improve its growth. A good pruning helps to balance vegetation and flowering. Finally, pruning the plant provides ventilation. Clean pruning shears of good quality must always be used. Cut sideways, making clean and smooth incisions. The secret is to not cause any sores to the plant. Observation and experience will be the best guides for the best time to prune.

General pruning instructions:

• Most deciduous trees should be pruned when dormant, during late autumn or winter. Should not be pruned in early spring, as many trees bleed if cut at this time of the year.

• Exceptions of deciduous trees are maple, horse chestnut, birch, walnut, and cherry, which all bleed heavily even during the end of the dormancy period. Therefore, they need to be treated during mid-summer, after the new flower has matured.

• The conifers require little or no regular pruning, except of removing the dead or diseased branches during late summer.

• It should be noted that in any major procedure, one that might require a pruning saw or require a ladder for example, a qualified expert alone should be taking care, both for personal safety and the good care of the trees.

4. Gardening tricks

In the table below there are some potential tricks/traps of gardening and their potential solutions

A/A	TRICKS	SOLUTION
1.	Planting near a wall. The plants will have trouble developing and will suffer from diseases and fungi. The reason is very simple, no good air circulation occurs when very close to a wall.	Plants should be planted at least two feet away from a wall.
2.	Planting in straight or curved lines, not necessarily a mistake occurs very often in gardening. For any reason, some of the plants may not develop properly or even dry, compared to others that may have a healthy development. The view will be disappointing. There is danger of exposing the whole planting project.	If aiming to place five plants in a row, it is best to buy six or seven at the same time, and plant the supplementary ones somewhere else within the garden. This way, anything goes wrong with a plant, it can easily be replaced with one of the supplementary ones, which logically will have the same size as the rest of the 'line'.

3.	Planting on slop may create a problem, as water tends to flow faster and therefore it will not penetrate the soil properly and not all plants will receive an equal amount of water. On steep slopes it can also create erosions in the ground.	Regardless of what is planted, a planting level should be maintained where the soil should be flat at each point, so the plants will grow on an even surface. If forced to plant on steepy ground, terraced planting is more preferable. This requires a lot of digging and regular maintenance of the walls, which means more work to be done.
4.	A not so unusual situation is for a garden to be divided into two: Half the garden is exposed to sunlight whereas the other half is in full shade. Planting at this point can be very tricky, especially if the scenario between sunlight and shade changes throughout the day.	Keep the situation under control by checking the hourly conditions throughout the day. Pay close attention on which parts receive the most sunlight. Only then can decisions be taken on which plant is going to be placed where. Always keep in mind that most plants can grow evenly even with minimal sun, maybe three to four hours.

		Other plants may only require one or two hours of exposure to sunlight, and specifically to morning sunlight.
5.	Garden planting and application of trees in private section areas, may cause some serious damage, when branches, even roots, of trees and plants begin to extend further outside the property limits. Extreme caution must be taken when branches may be nearing power lines, gas pipelines and water supply pipelines. Although planting near such settlements is legal, if repair services need to intervene for any reason, they carry no responsibility towards the plants or trees, or even the arrangement in general. Also, a problem might be presented, when twigs from branches extended outside the property limits break, and cause damage to pedestrians passing by or parked cars.	Avoid planting anything in such areas. Any type of garden site should not be placed upon concrete slab. In most cases, such a structure is not legal (a permit would be required). It is best for trees not to be planted below power line cables, since contractors have the power to bring them down, if considered unsuitable.

6.	Lawn mowers are a threat to trees and shrubs (especially during their early stages of growth). Random blows from lawn mowers in the trunks of trees may cause irreversible damage.	Lawn should be trimmed to roughly the same height, while looking to avoid tree trunks when doing so.
7.	Children after a game usually pollute the lawn with trash. If these trash are left unattended for a couple of days, especially in warmer climates, can harm the lawn permanently.	Try and remove all kinds of litter from the lawn as soon as possible.

5. Module Summary

The main outcomes of this section are the following:

- Knowledge of general facts about the history and definition of gardening
- Main types of gardening
- Basic gardening techniques
- Gardening tricks and ways to resolve them

Learning Outcomes:

Chapter 2:

- Definition of gardening
- Background
- Main types

Chapter 3:

- Basic instructions on preparation/taking care of

Chapter 4:

- Identifying possible tricks/traps and ways to resolve them

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Bemidji State University 2011 Gardening Case Study

SCHOOL

Bemidji State University is a 4-year public school with approximately 5,000 students in Bemidji, Minnesota.

ABSTRACT

The ***Gitigaan*** Campus Garden project was a collaboration of the Sustainability Office, GeographyClub, and Students for the Environment, a People and the Environment class, and Gounds Crew. The garden was built in May of 2011, and twenty-eight plots are rented to students, staff, and faculty and community members. The project cost about $1,000, and took about a month to accomplish. The materials were paid for by the student Green Fee at Bemidji State, which is a five dollar fee each semester for students. Plots are rented for only five dollars each to keep them accessible to students and allows for a maximum return on investment in about 7 years.

GOALS AND OUTCOMES

Goals

The initial goals for the project were to allow people to be more self-sufficient, eat organic produce and eat locally. College students may care about these things, but costs can be a barrier. Gardening allows students to grow their own produce and become more closely connected with nature

Our quantifiable goals for the project were to have the space chosen tilled, a fence built, plots sectioned out, and to create workshops to teach people how to cook and preserve their produce. At first raised beds were planned on because the site chosen was extremely sandy and we thought that raised beds and trucked in dirt would be sufficient to hold moisture. This became too overwhelming for us because of the added costs and time constraints. For following years, our goals are to continue improving the program by selling plots earlier in the year and doing more education/socialization events. Other improvements would be to mulch the pathways early to reduce weeds, develop a set of rules for the gardeners (i.e. a “weeding’’ deposit that can be kept if possible do not weed), and deadlines for people to plant. Our biggest issues were that some plot renters procrastinated with planting, which we wanted to avoid so that weeds did not take over and lead to disapproval from our university and neighbours.

We still want to add a system for watering the garden with rain barrels. We plan to build a small tool shed on to which we will attach a rain barrel. There is a house that was donated to the university that we could put more rain barrels under. For the time being, we are able to use an outdoor spigot for our watering. We built a compost bin for the weeds in the garden that will help add nutrients to the soil in years to come.

Accomplishments and Outcomes

Our garden has been a huge success thus far. Its size came out to be 59’ by 99’. There are twenty-eight plots that are about 12’ by 12’. We put in walkways strategically to maximize growing space. The plot renters are very dedicated, and we have experienced few weedy plots. At certain times of the week (around 5 o’clock or Saturdays); multiple people can be found tending their plot, and this has been a great socialization opportunity.

Challenges and Responses

The first challenge we faced was the location of the garden. Our campus Foundation had purchased a large parcel of property where a high school had been torn down. It was close to campus and would have been highly visible. However, there was no water available. The university has had to cut its budget, so the property will likely be sold in a few years. We reluctantly gave up that opportunity and looked closer at a property that was purchased by campus and was nearly turned into a parking lot. The residents of the neighbourhood rallied against the decision to do this, and the

project was terminated. It had great sun exposure, and was located close to the middle of campus. Most of our time was used determining the location of the garden, and we had to hurriedly plan the actual construction of the garden. We contemplated applying for grants, but we did not have enough time. We applied and asked for donations around the community, but many places had already donated materials to other organizations. Our Sustainability Coordinator encouraged us to apply for Green Fee funds, especially if the costs could be recouped after the garden was operating. The labor was to be done by Sustainability Office workers.

Because the site was sandy, we needed to amend the soil. Luckily, we were able to locate composted manure. The challenge was to find a way to efficiently haul the manure to campus. At first, we tried to sign our friends up who had trucks to volunteer their time and help haul. That work-day was cancelled because of snowfall and wet conditions. After finals, the Grounds Crew agreed to help us with one of their dump trucks. We had to check on the tonnage loads of the roads leading to the farm. This greatly simplified things, for we just needed to pay the farmer for loading the truck with his skid loader. We were able to put six loads of manure mixed with black dirt onto our garden. We hand-shoveled the dirt/manure mixture to limit compression of the soil.

Another challenge was the wet spring. It snowed on the day we wanted to begin the initial work for the garden, where we had lined up classes to come and help us and earn some of their required service hours. We had to cancel that, and due to finals we did not begin building until summer time

employment through the Sustainability Office. We also had to wait longer for the manure we wanted to amend the soil with because the farmer had a clay-filled lot, which was too slippery for the large truck we needed to haul the manure.

Applying for grants early in the onset of ideas like this would help ensure funding. Having an organized and dedicated planning committee with experience in gardening helps a lot. People around campus can help a lot with projects like this. They know the area well, and probably have contacts for famers with rotted manure, lumber, etc. Just talking to people about the project helped us secure what we needed to create it. Some may even help with construction if the student group lacks the skills or tools. We borrowed tools from our campus grounds crew, and they helped with a tiller that one of the geography students lent us.

Campus Climate Action: Your School's Carbon Footprint

We indirectly addressed climate change because of the energy cost of food. Much of the nation's produce comes from California in the San Joaquin valley, which is dealing with water stress and the produce then needs to be trucked all over the country. Many fruits and vegetables are shipped over 1,500 miles from farm to grocery store. We obtained this information from

http://www.leopold.iastate.edu/pubs/staff/ppp/index.htm and http://www.newsweek.com/2009/08/23/dying-on-the-vine.html. Enabling gardening and teaching how to preserve food helps alleviate dependence on this wasteful system.

Commentary and Reflection

Our garden has been a huge success. People are excited to see such a lush garden. We get a lot of people to stop and look at it. We managed to rent out all of our plots within a month. It was a lot of work, but all worth it. Our staff in the Sustainability Office and all the planners are proud to have made such a great impact on our campus.

ENGAGEMENT AND SUPPORT

Leaders and Supporters

We worked closely in the planning stage with the Bemidji State Geography club. One student in particular was especially helpful, and we set up meetings and made decisions. It was awesome to have such a great partner to accomplish such a large task. We also had help from a lot of other students, which showed us that there was a huge interest in the project. We needed help from

administration to allow us to build this on campus property. Our Vice President of Financing was the biggest supporter here, as well as the Director of the Physical Plant, the President of the University, and Grounds Crew. We also contacted the local neighborhood group that kept the lot from becoming a parking lot. We made sure to contact all parties interested in the property. We considered our size and spacing for mowing purposes so that Grounds Crew staff would not have to struggle because of our project. This took a long time, but it was worth it because now we have strong support and appreciation for the project. When we were able to begin construction in May, a summer class of People and the Environment helped us dig up sod so that we could till easier. That work would have taken us two weeks to accomplish without them!

Funding and Resources

Fence posts- $150

Wire fence mesh- $150

Fence staples- $10

Manure loading- $240

Fuel for tiller- $20

Fine mesh to keep small animals out.- $150

Tools- $120 (shovels, post hole digger, rakes, pitch forks…)

Lawn Edging- $150

Total=$990

The project was supported by the Sustainability Office and the student Green Fee both for the material costs and the labor of three student workers.

Education and Community Outreach

We contacted a group that represented the neighborhood before we created the garden to get their blessing for the project. The land is now owned by the university, but there are still many families not

affiliated with the university that live in the area. People embraced the project. During construction, many passers-by would ask why we were digging up the grass. Everyone we spoke to was excited about a garden coming. Now, we have left a portion of the garden outside the fence, which is meant for community members without a plot to take. A video is being created, and we will be featured in the local newspaper. The garden can be a learning tool in classrooms geared towards sustainability. This can be a spring board for more traditional skills workshops; which the Sustainability Office hosts to teach people forgotten skills that help them be more self sufficient and sustainable. We made use of our sod by donating it to a local LEED-certifiable homeless shelter that had just been built. Plot Renters are encouraged to donate excess produce to the Food Shelf.

Allied Domecq Spirits: The use of Belbin Team Roles in the Change Strategy Process

Allied Domecq Spirits and Wines is the second largest drinks company in the world, with a turnover in excess of £3 billion, and employs over 10,000 people internationally.

In 1994 Allied created a unique internal and growth consultancy, ADventure. The mission was to create a culture of Innovation throughout the company, and liberate the Social Capital potential latent in the diverse teams around the business. A key tool in this process was the Belbin instrument, which was used extensively

Between 1998 and 2001, head of ADventure (AD), Paul Wielgus, worked closely with the Managing Director of Allied in Central and Eastern Europe (CEE), Chris Zanetti. Their mission was to harness the cultural diversity across 12 countries, in order to achieve stretching corporate goals.

Prior to 1998 the culture in the region was very directive, run on a command and control basis from a regional H.Q. in Brussels. The markets were dependent on orders issued from the “centre” There was little/ no networking below the level of MDs and little transfer of best practice

However, there was a strong “work ethic” and some excellent work in connecting with consumers. It was evident, however, that the company was not using its resources of people, systems and creativity in the most effective way for the benefit of consumers and ultimately AD as a whole. The company simply had previously not recognised the potential in the diversity of the people in the region.

Changing the culture

As newly appointed MD, Chris called in Paul to help with his new strategy for CEE. Chris wanted to completely transform the culture as follows:

- He wanted to create a culture of interdependence across the region
- He wanted to understand, identify and harness the skills of the people and teams within and across the region, in order to harness the potential and deliver the strategy and business goals. The Belbin instrument was a fundamental tool to achieve this

The initial focus in implementing the strategy was on leadership and team building and creating the capability to deliver the strategy. Specifically, Belbin was used to:

- Develop Organisational trust comprising trust in each other and trust in the team to deliver.
- Give a common language across the region, and prepare the foundation for a powerful network that could be relied on for information and support.
- Help identify specific talents and roles for individuals across the region, and facilitate the allocation of team roles to specific projects.
- Enable the company to develop a culture of interactivity that was no longer top-down, but sought input at all levels in order to effectively achieve company goals.

- Build energy during the many workshops that were run during the period, through using Belbin as a component part of a range of innovative “action learning” interventions.

Outcomes

- The creation and delivery of a credible and robust strategy, which delivered 55% profit growth in less than 3 years.
- The development of a rich, diverse team culture, which developed its skills in the delivery of high quality service and brands in the consumer marketing arena.
- Powerful personal and professional development for individuals.
- A strong reputation for customer of choice within and outside of Allied Domecq. In particular the region posted some impressive results in their Employee Opinion Survey, particularly around dimensions such as team working, job satisfaction, customer service and learning.

Paul Wielgus, Social Innovation

Wells, UK, Chris Zanetti

Allied Domecq