

BIOCOMPOSTING

1. Bio Composting is the aerobic bio- degradation of organic materials under controlled conditions, resulting in a rich humus-like material. □ Or □ A mixture of organic matter, as from leaves and manure, that has decayed or has been digested by organisms, used to improve soil structure and provide nutrients.
2. In natural systems, no such thing as "waste" exists. Energy and matter captured by life processes are released upon the breakdown of organic substances only to be re-utilized by living organisms within the system. Long-term soil fertility is maintained in natural systems because the residues of biological decomposition are reused by them to foster new growth. The transformation and flow of the nutrient- containing chemical compounds involved in this process is often referred to as "nutrient cycling". Nutrient cycling helps ensure the stability of natural systems over time by linking the processes of synthesis (build-up) and degradation (breakdown).
3. Composting is differentiated from the natural decomposition of organic matter because it is a process controlled by humans. Much of this resource guide is dedicated to examining the factors that can be managed to optimize the composting process. Of course, organic materials are recycled by nature regardless of whether we compost them or not, but conditions may be regulated by humans to ensure a smooth process and the generation of a quality end product.
4. Compost supplies nutrients essential to plant growth. 2. Compost additions to soil help create organic reserves that release nutrients incrementally over many years 3. Compost can therefore be applied in large quantities to soil systems with little danger of excess nutrient accumulation. 4. Compost supplies other plant essential elements such as phosphorus, potassium, calcium, sulfur and micronutrients to varying degrees 5. Compost improves soil structure and tilth by lowering bulk densities, by increasing permeability and porosity and by introducing microorganisms 6. Compost help mprove the soil's ability to retain plant nutrients (which are often in cationic form). Calcium, magnesium and potassium, for example, can all be held on exchange sites. 7. Compost can also help a soil retain fertilizer, pesticides, and herbicides, thus decreasing their loss by erosion, leaching, and runoff

5. 'Bio-degradation' simply means the breakdown of materials by living organisms (primarily microbes). 'Organic materials' are all those materials that were once living themselves (eg leaves, grass clippings etc) or are the waste products of living organisms (eg manure). 'Controlled conditions' simply means that it doesn't happen by accident.
 2. There needs to be some human intention and assistance involved.
 3. Finally, 'humus' (not to be confused with hummus is a dark, stabilized organic material that is essentially at, or at least near, the end of the road as far as decomposition goes.
 4. It plays a very important role in overall soil fertility (rich, healthy soils tend to have a higher proportion of humus).
6. A product that is "compostable" is one that can be placed into a composition of decaying biodegradable materials, and eventually turns into a nutrient-rich material. It is almost synonymous with "biodegradable", except it is limited to solid materials and does not refer to liquids. □ Composting occurs in nature every day as fallen leaves and tree limbs biodegrade into the forest floor. The EPA considers composting a form of recycling because it turns resources into a usable product. □ Compost piles have been used by many farmers and gardeners for generations. Food, leaves, grass clippings, garden wastes, and tree trimmings (which amount to between 50 and 70 percent of waste in this country) can all go into the compost pile, where hungry microorganisms eat the waste to produce carbon dioxide, water and humus. The resulting compost is an excellent natural fertilizer proven by organic gardeners to restore soil fertility, control weeds, retain ground moisture and reduce soil erosion.
7. "A compostable item is capable of undergoing biological decomposition in a compost site. Requirements: □ 1. Disintegration: Item must achieve 90% disintegration in 90 days □ 2. Biodegradation: Item must demonstrate a 60% conversion to CO₂ within 180 days □ (conversion to CO₂ and biomass continues even after 180 days) □ 3. Item leaves no toxicity in soil
8. The composting process is carried out by a diverse population of predominantly aerobic micro-organisms that decompose organic material in order to grow and reproduce. The activity of these micro-organisms is encouraged through management of the carbon-nitrogen (C:N) ratio, oxygen supply, moisture content, temperature, and pH of the compost pile. Properly managed composting increases the rate of natural decomposition and generates sufficient heat to destroy weed seeds, pathogens, and fly larvae.

9. What's the difference!? Compostable means that an item will turn into nutrient-rich soil within a specific timeline Certification standards require specific timelines in order for products to be called compostable. Everything that is compostable is biodegradable, but not everything that is biodegradable is compostable! Claiming that an item is biodegradable means nothing without providing context of the conditions in which the item will biodegrade. It could biodegrade anywhere from a month to 10,000 years!
10. The composting process can be divided into two main periods: (1) active composting and (2) curing. Active composting is the period of vigorous microbial activity during which readily degradable material is decomposed as well as some of the more decay-resistant material, such as cellulose. Curing follows active composting and is characterized by a lower level of microbial activity and the further decomposition of the products of the active composting stage. When

VERMICULTURE

What is Vermiculture?

The term vermiculture mainly refers to the scientific process of cultivating worm or artificial rearing of worms to decompose organic food wastes into a nutrient-rich material. The output of vermiculture is called vermicompost and is formed by the process in which earthworms consume the farmyard manure and roughages in addition to the wastes from farms and thereby producing it. The produced vermicompost is rich in terms of nutrients and other plant growth-promoting substances, which is capable of supplying necessary mineral nutrients to help and sustain plants growth.

Vermicompost Preparation

The primary components used in the preparation of Vermicompost include different types of wastes, including the household garbage, industrial wastes in liquid form and wastes from the municipality can also be used.

For culturing earthworms, crop residues, dry leaves, cattle dung, sawdust, coir waste, paddy husk, slurry from the biogas plant, poultry waste and vegetable wastes are the basic materials and the complete process of culturing should be done under shelter to avoid direct sunlight and flooding by heavy rain

Most of us would be surprised by the fact that these earthworms are essential for maintaining a healthy environment rather than just converting garbage to useful manure. The process of earthworm multiplication and garbage conversion by earthworms into compost are very simple, that farmers could do it by themselves.

How to Multiply Earthworms in Large Scale

The best method used by farmers to multiply the earthworms is by mixing more number of biodegradable wastes, including the plant materials, dried leaves and cow dung in a proportion of 1:1. Once the medium is done, around 40-50 earthworms species are released into the medium and protected it from sun, rain and other prey. Regular maintenance is required, keep a check at the moisture level by sprinkling water over it on a timely basis. Within a timeframe of one to two months, the earthworms would multiply by 300 times relying on this process alone. Thus, the new earthworms would assist us in preparing the vermicompost.

Merits of Vermicomposting

- Since it does not contain chemical elements, vermicompost being prepared from organic wastes (biodegradable) is a natural fertilizer and eco-friendly too.
- Does not impact the environment, soil, and plants adversely.
- Soil compaction is reduced by it by boosting the soil aeration, tilth and texture.
- Owing to its high organic matter content, it improves the soil's water retention capacity.
- Better nutrient absorption and root growth are promoted by it.
- Both the micro and macronutrients of the soil status are improved by its use.

Safety Measures

- The pit for the compost should be shielded from exposure to sunlight
- Guard the worms against pests and rats, bird, ants, etc.
- Sprinkle water on the pit when necessary to sustain the moisture level.

From the above discussion, one could state beyond doubt that earthworms are certainly one of the significant creatures on earth despite them being tiny in size

ORGANIC FARMING

1. What is Organic Farming? □ Organic farming is the production of crops and livestock without the use of synthetic chemicals and in-organic fertilizers. □ Organic agriculture aims at the human welfare without any harm to the environment which is the foundation of human life itself. 3
2. History of Organic Farming □ Organic farming was practiced in India since thousands of years. Agriculture was practiced using organic techniques, where the fertilizers, pesticides, etc., were obtained from plant and animal products. □ Post-independent India witnessed severe food crisis. □ India depended on heavy imports of food-for-aid from western countries. □ Green Revolution introduced in 1970's changed the situation from food importer to food exporter by 1990
3. What is Organic agriculture □ Organic agriculture is a production system that sustains the health of soil, ecosystem and people. □ It relies on ecological processes, biodiversity and biological cycles adapted to local conditions, rather than the use of synthetic inputs with adverse effects. □ Organic agriculture combines tradition, innovation and science to benefit the environment and promote fair relationships and a good quality life for all involved.
4. Why Organic □ Healthy food: Contains no toxic substances □ „Natural & Good taste □ „Higher benefit cost ratio due to less external input use and premium price (20-25%) □ „Takes care of Environmental concerns of Farming
5. Why farm organically? Organic farming aims to: □ increase long-term soil fertility. □ control pests and diseases without harming the environment. □ ensure that water stays clean and safe. □ use resources which the farmer already has, so the farmer needs less money to buy farm inputs. □ produce nutritious food, feed for animals and high quality crops to sell at a good price.
6. What is conventional/ modern agriculture? □ Modern agriculture uses pesticides, herbicides, fungicides, rodenticides and harmful chemicals to produce the food we eat. □ The food produced from conventional agriculture is harmful to human health because they contain residues of chemicals and in-organic fertilizers.
7. Intensive Farming - chemicals ®Many different chemicals are used to make plants and animals grow faster ®Intensive farmers use artificial fertilizers and growth promoters. ®It is easier to use than manure and smaller quantities are needed, because it contains

more of the elements. ®Artificial fertilizers are spread on the ground or sprayed on the crops.

8. Intensive Farming - chemicals Problems: ® They do not just disappear but stay in the plants that we eat, so our food is contaminated with chemicals. ® Soil used to grow the plants will also be contaminated and have chemicals in it for a very long time. ® Animals eat the grass , which has had chemicals sprayed on to it, so the chemicals get into their blood and therefore the meat that we eat. ® Chemicals run off the land into rivers and kill plants and fish.
9. ORGANIC farming □ Artificial fertilizers are banned in Organic farming. □ Organic farmers use animal manure, compost and human sewage, (which has been heated to destroy any harmful microbes) to make their crops grow. □ ‘Green manure’ is grown – plants are grown, then ploughed in and left to rot. □ Worms, insects and bacteria underground are always working on making the soil good. □ By using a process called CROP ROTATION (changing the crop grown each year), the farmer can keep a good soil for many years.
10. Advantages Organic farming Fewer workers needed Fewer blemishes on crops Produce is cheaper Large numbers of animals kept in ideal conditions Bigger yields from land available Antibiotics use keeps animals healthy Use of hormones increases meat production Soil structure is better Less harmful to environment More birds and insects Animals lead happier lives No harmful chemicals – healthier?
11. Man-made chemicals used Chemicals stay in soil Organic farming Natural predators destroyed Chemicals wash into rivers Animals live in crowded conditions Smaller yields Hedgerow habitats destroyed More blemishes on crops More expensive More farm workers needed Disadvantages
12. Modern Chemical Farming creates “Dead Soil” □ Acidic soils with few microorganisms □ Lacking in micro elements, trace elements, poor vitality □ Almost O organic matter
13. Organic Farming creates “Living Soil” □ Full of life with microorganism, fungi, worms and termites. □ Very rich in macro and micro elements, trace elements, and vital energy □ Very rich in organic matter.
- 14.

BIOMINERALIZATION

Biomaterialization is the study of biologically produced materials, such as shells, bone, and teeth, and the processes that lead to the formation of these hierarchically structured organic–inorganic composites. The mechanical, optical, and magnetic properties of these materials are exploited by the organisms for a variety of purposes. These properties are often optimized for a given function as compared to the properties of a biological materials of similar composition. Materials chemists are intrigued by the exceptional control organisms exert over the composition, crystallography, morphology, and materials properties of biominerals and the mild conditions (physiological temperature, pressure, and pH) required to form them. In recent years, therefore, the field of biomaterialization has expanded to include the application of strategies adapted from biology to the production of synthetic materials. Biomaterialization is by definition a multidisciplinary field that draws on researchers from biology, chemistry, geology, materials science, and beyond. In this issue, we focus on the role that chemistry, broadly defined, has played and will continue to play in the development of this growing field.

The impact of chemistry in the field of biomaterialization can roughly be divided into three different areas: (1) the characterization of the crystallography, composition, and biochemistry of the biological materials; (2) the design of *in vitro* model systems to answer questions from biology such as testing hypotheses regarding the interactions between the organic matrix and the crystals and the role of biomacromolecules in controlling nucleation and growth of crystals; and (3) the development of new synthetic methods, which are based upon the biological systems, for controlling crystal morphology, polymorph, and materials properties, leading to new classes of organic–inorganic composites. All three of these approaches are highlighted in the 22 articles assembled for this issue.

The articles are arranged loosely by mineral class (e.g., carbonates, phosphates). Within each section, the articles are further organized beginning with reviews that cover fundamental aspects of biomaterialization and moving to reviews that address bioinspired materials applications. The first review by Meldrum and Cölfen serves as an excellent introduction to many of these topics. Specifically, they provide an overview of recent developments in understanding crystal nucleation and growth mechanisms in both biological and synthetic systems and how these processes can be modified to form crystals with unusual morphologies, structures, and properties.

The processes of biomineralization are often under strict biological control and involve the interactions of a large number of biological macromolecules. In recent years, much progress has been made toward determining the sequences and solution-state structures of these biomacromolecules as well as establishing structure–function relationships for them.

In addition to the control exerted by the organisms over carbonate crystallization, the environment in which these organisms grow can also substantially influence the production of these minerals. Stanley reviews this hotly debated, and timely, topic in an article that addresses the effects of seawater chemistry (e.g., calcium-to-magnesium ratio and pH) and atmospheric carbon dioxide levels on mineralization in coccolithophores, calcareous algae, corals, and other carbonate-producing organisms.

The last two articles in the carbonate section cover the work of polymer and organic chemists toward the design of synthetic additives to control the crystallographic orientation, morphology, and polymorph of carbonate-based minerals. Sommerdijk and de With provide a thorough review of the rapidly growing field of bioinspired “designer” small molecules and interfaces (e.g., self-assembled monolayers and Langmuir monolayers) to control the nucleation, polymorphism, structure, and composition of crystals and organic–inorganic composites. In her article, Gower discusses the role of amorphous calcium carbonate precursors, which are stabilized by polyelectrolytes, in the formation of crystalline structures in both synthetic and biological systems.

After the carbonate minerals, the phosphates are the second most prevalent family of biominerals. Since our bones and teeth are both composed of carbonated apatite (an orthophosphate) crystals embedded within an organic framework, there is an emphasis in the biomedical community on such systems. We begin this section with a review by Wang and Nancollas describing the physical chemistry of the orthophosphates. A fundamental understanding of crystal growth and dissolution for this class of materials *in vitro* is essential for analyzing and modeling the biological systems.

A family of highly phosphorylated proteins is closely associated with the production of phosphate minerals *in vivo*. George and Veis review both *in vitro* and *in vivo* experiments that elucidate the role these proteins play in controlling the biomineralization of orthophosphates, such as carbonated apatite. In Omelon and Grynopas’s contribution, they discuss polyphosphates, an interesting class of biomacromolecules whose role in biomineralization is just recently becoming appreciated.

Boskey and Roy review the specialized cell-culture techniques, that have been developed to study biomineralization of bone and teeth in vitro. Of key importance in these studies is the identification and characterization of the mineral phase and the “biological relevance” of the mineral phase that is formed. This review addresses both of these issues and provides guidelines for designing future cell-based studies of mineralization.

The characterization, in situ, of the macro- and microscopic 3-D structures of biomineralized tissues is essential for understanding the spatial distribution of minerals during tissue development. Neues and Epple review the emerging field of synchrotron radiation microcomputer tomography (μ CT) for imaging mineralized structures, at high resolution, in a nondestructive manner.

Immense attention has been paid to the development of osteoconductive and osteoinductive materials, materials that can stimulate the production of new bone in vivo, for use in biomedical implants for the repair of damaged hard tissues. LeGeros reviews different calcium phosphate based materials for this purpose. In the contribution from Stupp and co-workers, they present recent developments in the design of structurally complex organic templates to promote hydroxyapatite mineralization and bone repair, in vivo. Unlike traditional biomaterials, these newer synthetic constructs often incorporate multiple components, each with a specific biological function (e.g., chemical signals to promote both cell adhesion and mineralization).

In addition to the carbonates and the phosphates, there is a wide range of other inorganic minerals and organic crystals formed by biological organisms. We conclude this issue with a series of articles that cover some of these other systems and the techniques used to study them. Atomic force microscopy (AFM) can provide insight into the dynamics of crystallization, including the mechanisms by which small molecules and proteins can inhibit and/or modify crystal growth. Qiu and Orme review applications of AFM to study, among other systems, the crystallization of calcium oxalate, one of the main components of kidney stones. In recent years, molecular dynamics and other computational techniques have been applied to modeling crystal nucleation and growth. Harding and co-workers review how these computational techniques are applied to a range of biological and synthetic systems to provide insight into the role of the organic–inorganic interface in controlling crystallization.

The next articles cover three specific examples of different types of biominerals and the biological organisms that produce them. Hildebrand reviews the formation of amorphous silica by diatoms, with a focus on how genomics can contribute to our understanding of

biomineralization processes. Faivre and Schüler examine the formation of magnetic minerals by magnetotactic bacteria and the macromolecules that are involved. The only review in this issue to address organic crystal growth in biology is by Weissbuch and Leiserowitz, who discuss the formation of hemozoin crystals by the parasite that causes malaria. In particular, they highlight the role that molecular recognition and crystal design can play in developing novel treatments for malaria by inhibiting the growth of hemozoin crystals and, thus, poisoning the parasites.

Finally, two reviews highlight bioinspired materials synthesis based upon a wide range of mineralizing systems. Brutchey and Morse focus on a protein, silicatein, which is isolated from the silica spicules of a marine sponge, to design new polymers and interfaces to control the growth of inorganic materials, including some that are important for energy production and storage. Dickerson, Sandhage, and Naik address the rapidly emerging field of protein- and peptide-directed synthesis of inorganic materials, including ceramic oxides, semiconductors, and metallic nanoparticles.

BIOFUELS

1. WHAT ARE BIOFUELS? □ Biofuels are liquid fuels that have been developed from other materials such as plants or animal waste matter.
2. WHY BIOFUELES? □ Biofuels production and consumption ensures that the natural Carbon cycle to be 100% achieved which completely eliminates the continuous increase in Carbon Dioxide rates in the atmosphere which in turns will have the greatest effect on the environment and a way to end global warming □ For example, A crop of plants used to produce a barrel of biofuel will absorb exactly the same amount of Carbon Dioxide as emitted from burning the barrel produced.
3. TYPES OF BIOFULES First generation biofuels Bioalcohol Biodiesel Vegetable oil Biogas Syngas Solid biofuels Second generation biofuels Main two types
4. BIOETHANOL □ Bioethanol is an alcohol made by fermentation, mostly from carbohydrates produces in sugar or starch crops such as corn or sugarcane. □ Cellulosic biomass, derived from non-food sources such as trees and grasses, is also being developed as a feedstock for ethanol production. □ Used to substitute petrol fuel for the road transport vehicles □ One of the widely used alternative automotive fuels in the world (Brazil & USA are the largest ethanol producers) □ Much more environment friendly and have low toxicity level
5. Bioethanol Production
6. Applications of Bioethanol: Transport fuel to replace gasoline Fuel for power generation by thermal combustion Fuel for fuel cells by thermochemical reaction Fuels in cogeneration systems Feedstock in the chemical industry Blending ethanol with small portion of gasoline is more cost-effective
7. Advantages of Bioethanol □ Burns more cleanly as a result of more complete combustion □ Reduces greenhouse gases □ It is carbon neutral □ Decrease in ozone formation □ Renewable energy resource □ Fuel spills are more easily biodegraded or diluted to non-toxic concentration □ Any plant can be used for production of bioethanol : it only has to contain sugar and starch
8. Disadvantages of Bioethanol □ Large amount of arable land is required to grow crops, natural habitats would be destroyed. □ Due to lucrative prices of bioethanol, some farmers may sacrifice food crops for biofuels which will increase food prices around

the world. □ During production of bioethanol, huge amount of carbon dioxide is released. □ Not as efficient as petroleum □ Cold start difficulties □ Difficulty in transportation

9. BIODIESEL Biodiesel is a variety of ester-based oxygenated fuels derived from natural, renewable biological sources such as vegetable oils. □ Biodiesel operates in compression ignition engines like petroleum diesel thereby requiring no essential engine modifications. □ Unlike fossil diesel, pure biodiesel is biodegradable, non-toxic and essentially free of sulphur and aromatics. □

10. Biodiesel Production

11. Advantages of Biodiesel □ Biodiesel is environmentfriendly. □ It can help reduce dependency on foreign oil. □ It helps to lubricate the engine itself, decreasing engine wear. □ It can be used in almost any diesel with little or no engine modification. □ It is safer than conventional diesel. □ Less global warming.

12. Disadvantages of Biodiesel □ Biodiesel emission increases Nox in atmosphere □ Biodiesel behaves as a solvent □ Slightly decreases fuel economy □ Cost varies according to feedstock used and market conditions.

13. USES OF BIOFUELS Cars and Trucks: Diesel cars and trucks can run on biodiesel. □ Aircraft: Recent testing has shown the viability of biofuel use in the aviation industry, and use of biofuels to power aircraft is expected to increase substantially in the next decade. □ Off-Road Equipment: A large percentage of off-road equipment -- such as vehicles used in agriculture, mining, forestry, construction, and power and heat production -use diesel fuel, making this equipment suitable for biodiesel use □ Small Engines: Small engines, like those found in lawn mowers and chainsaws, can use ethanol blends up to 10 percent without problems □

14. ADVANTAGES OF BIOFUELS □ □ □ □ □ □ Cost: Biofuels have the potential to be significantly less expensive than gasoline and other fossil fuels. Source material: Whereas oil is a limited resource that comes from specific materials, biofuels can be manufactured from a wide range of materials including crop waste, manure, and other byproducts. This makes it an efficient step in recycling. Renewability: It takes a very long time for fossil fuels to be produced, but biofuels are much more easily renewable as new crops are grown and waste material is collected. Security: Biofuels can be produced locally, which decreases the nation's dependence upon foreign energy Economic stimulation: Because biofuels are produced locally, biofuel manufacturing

plants can employ hundreds or thousands of workers, creating new jobs in rural areas. Lower carbon emissions: When biofuels are burned, they produce significantly less carbon output and fewer toxins, making them a safer alternative to preserve atmospheric quality and lower air pollution.

15. DISADVANTAGES OF BIOFUELS □ □ □ □ □ Production carbon emissions: Several studies have been conducted to analyze the carbon footprint of biofuels, and while they may be cleaner to burn, there are strong indications that the process to produce the fuel including the machinery necessary to cultivate the crops and the plants to produce the fuel - has hefty carbon emissions. High cost: To refine biofuels to more efficient energy outputs, and to build the necessary manufacturing plants to increase biofuel quantities, a high initial investment is often required. Food prices: As demand for food crops such as corn grows for biofuel production, it could also raise prices for necessary staple food crops. Food shortages: There is concern that using valuable cropland to grow fuel crops could have an impact on the cost of food and could possibly lead to food shortages. Water use: Massive quantities of water are required for proper irrigation of biofuel crops as well as to manufacture the fuel, which could strain local and regional water resources.
16. CONCLUSIONS Biofuels can be defined as solid, liquid or gas fuel derived from recently dead biological material which differ it from fossil fuels that derived from long dead biological material. □ Biofuels production and consumption will contribute in solving the global warming. It ensures that the natural Carbon cycle to be 100% achieved. □ □ Agriculture sources produce many types of agro fuel, but the two main products are: ethanol and biodiesel. Ethanol is produced from sugar crops, starches and cellulose. It produced by fermentation process of materials containing sugar. While biodiesel is produced from soybean, oils, seed oils and fats. These agro fuels economically, creates permanent jobs, and environmentally reduces air pollutant emissions. However, using agriculture crops in their production results in increasing essential food crops' prices. □ Many biofuels are now produced from organic wastes such as biodiesel which produced from cooking oils, methane from anaerobic digestion and ethanol from wood waste.

AGRICULTURE CHEMICALS

AGROCHEMICALS

Chemical products used in agriculture are termed as AGROCHEMICAL.

Types of agrochemical:

Pesticides

Herbicides

Insecticides

Fungicides

Synthetic fertilisers

Hormones

Growth agents

Animal manure

Agrochemicals are used to improve quantity and quality of food.

Benefits of Agrochemicals:

Improves plant nutrition

Improve economic production

Improve quality of life

Demerits of Agrochemicals:

Reduce soil fertility

Harmful to the environment

Prefer organic farming over

Synthetic agrochemicals.

CROP PROTECTORS

PESTICIDES 1. It is used to kill, repel or control plants and animals that are considered as pests. 2. Pests are two types: a) Inorganic chemicals, that doesn't contain carbon. • Obtained from mineral ores extracted from the earth. • They include copper sulphate, copper and sulphur etc.

Organic pesticides, that contains carbon. • Obtained from plant and materials. • They include organochlorine, organophosphorus and pyrethroid compounds. 3. Act on nervous system of insects or by inhibiting the growth. 4. Ex: Malathion, Endosulfan and Lindan.

HERBICIDES 1. Destroy weeds and unwanted vegetation. 2. Crop protector. 3. Natural herbicides, allelopathic chemicals. 4. Some herbicides act on a particular class of plant growth regulators. Ex: 2,4-dichlorophenoxyacetic acid, which inhibits the growth of dicotyledons plant not monocotyledons. 5. Some herbicides persists in environment.

INSECTICIDES 1. Eliminates insects that are harmful to the plants. • 2. Action depends on chemical composition of insecticides: • On nervous system or • May harm exoskeleton. 3.Ex: Insect growth regulators like pyriproxyfen and methoprene, this don't allow insect to grow or lay eggs properly but don't necessarily kill them

FUNGICIDES 1. Removes fungal species that destroy plants 2. Damages fungal cell membranes or interfere with the cellular machinery of fungi that involves in energy production. 3.Eg: Benzimidazole, Imidazole, triazole, and dicarboximide

SOIL SUPPLEMENTS

FERTILISER 1. Definition: Any organic or inorganic chemical supplements added to the soil to provide essential nutrients for supporting plant growth and development called fertiliser. 2. Provides micro and macronutrients. 3. micronutrients: B, Zn, Cu, Fe etc. • Macronutrients, Ca, S, Mg, K etc. 4. Two type of fertiliser: • Inorganic • Organic

INORGANIC FERTILISERS 1. Easily dissolved in soil. 2. Rate of uptake by plants is high. 3. High concentration of micro and macronutrients. 4. DISADVANTAGE: • They contaminate the water, soil and environment. 5. Eg: Nitrogen and Potassium fertilisers.

ORGANIC FERTILISERS 1. Macro and micronutrients are released during the decay of organic matter. 2. Very slow process. 3. Low concentration of plant nutrients. 4. Improve fertility of soil. 5. Organic nutrients increases the organisms. • DISADVANTAGE: • May contain disease causing organisms.

HORMONES/GROWTH AGENTS 1. Are of Endogenous origin and are synthesised by plants. 2. These are Growth regulators

performing². These are Growth regulators performing specific function in overall development of specific function in overall development of the plant. the plant. Eg. hormone/growth regulator for Eg. hormone/growth regulator for enhancing root growth, controlling plant enhancing root growth, controlling plant height, improving fruit yeild etc. height, improving fruit yeild etc.

IMPACT ON THE ENVIRONMENT

AIR POLLUTION • The pesticides/ herbicides/ insecticides which are suspended in the air contribute to air pollution, when they are carried away to other areas due to wind. • The phenomenon is also known as pesticide drift.

WATER POLLUTION • It refers to pollution of water bodies such as ponds, lakes or rivers due to unintended mix up of synthetic herbicides/ fungicides/ pesticides

SOIL POLLUTION • It generally occurs when many of the pesticides/ insecticides/ herbicides is used for a prolonged period of time which adversely affects the soil quality and therefore polluting it.

ORGANIC FARMING • Organic farming is an alternative form of agriculture in which a variety of techniques such as crop rotation, green manure and compost are used. • Helps the soil in water retention, which increases productivity during drought