Soil Science and Technology
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Lecture – 40
Compost

Welcome guys into the, in this last lecture of week 8 of Soil Science and Technology. And will be trying to finish this soil organisms and then will be covering some basic aspects of composting and vermicomposting. So, let us start from the fungi.

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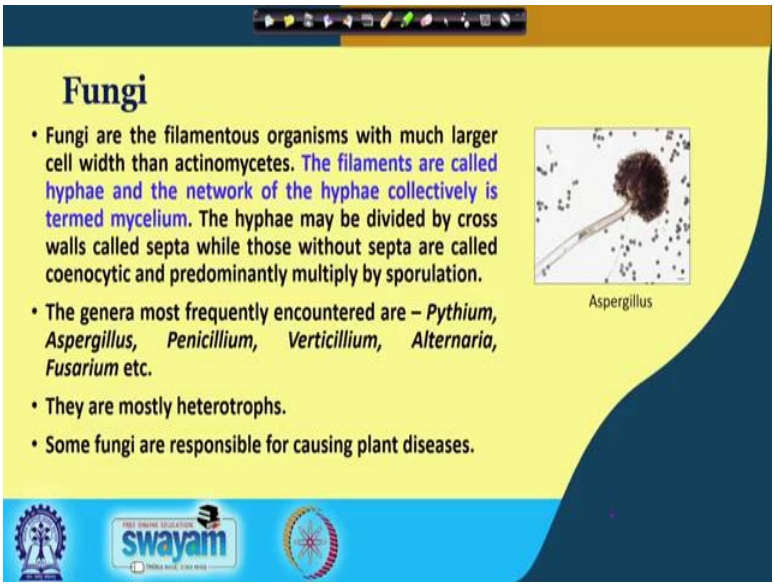

Now, fungi is another important soil micro flora. It is a smallest achlorophyllous plant I would say and fungi are the filamentous organisms with much larger cell width than that of actinomycetes. And the filaments are called hyphae and the network of hyphae is collectively termed as mycelium and the hyphae may be divided by cross wall called septa, while those without septa are called coenocytic and predominantly multiply by sporulum sporulation.

So, some important genera which are frequently found in soils are Pythium, Aspergillus, and Penicillium and then, you know, Verticillium, Alternaria, Fusarium and all this things. So, they are mostly heterotrophs and they grow basically within the dead bodies and, you know, dead organic matter they thrive on dead organic matter and some fungi

are responsible for causing the plant diseases also. So, you can see here aspergillus very important very important fungi soil fungi.

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Now, what is the role of soil fungi? So, fungi primarily responsible for the decomposition of organic matter and also the deposition of organic matter it is basically it should be read as decomposition of organic matter and some fungi form a symbiotic association we have already covered that symbiotic association we call it mycorrhizal association and guys we have already covered this VAM thing in our phosphorous lecture.

So, the association can be divided into, you know, that 2 types that is ectotrophic mycorrhizae examples are Boletus and Amenita and VAM that is basically orbuscular mycorrhizae examples are glomus and endogene. So, these are some examples of ectotrophic and endotropic mycorrhizae and basically you know that they increases the availability of the insoluble nutrients to the plants and also increases the mobility due to the faster intercellular nutrient mobility. So, that is why these fungi are very very indispensable for maintaining the soil fertility.

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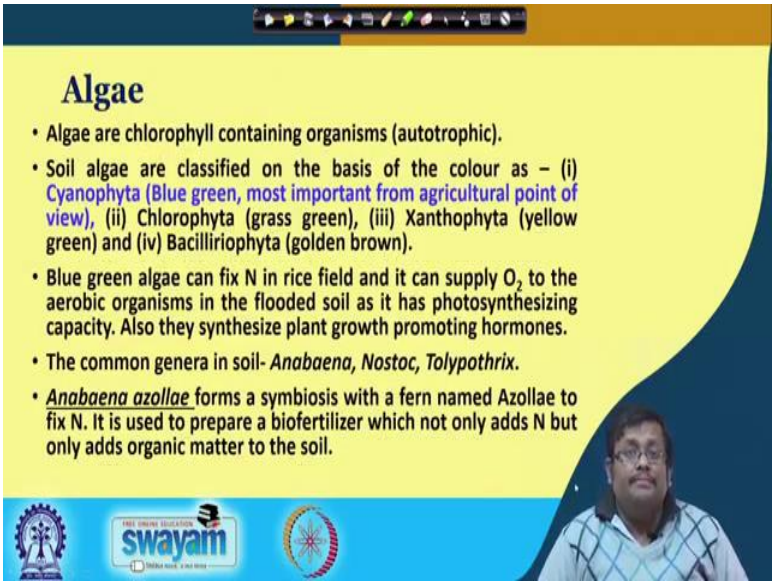

Now, let us let now next, let us talk about algae, algae you know chlorophyll containing organism which are basically autotrophic and the soil algae they classified based on their colour, there are 4 major classification. One is called Cyanophyta. This is the most important or these are also known as blue green algae.

These are important from the point of view agriculture point of view because, they synthesize the, you know, they are important for biological nitrogen fixation, the other groups are Chlorophyta which are grass green algae, Xanthophyta they are yellow green algae and Bacilliriophyta which are golden brown algae.

Now blue green algae, you know, that they can fix nitrogen in rice field and it can supply oxygen to the aerobic organism in the flooded soil as it has photosynthesising capacity also. So, also they synthesize plant growth promoting hormones. So, the common genera in the soil are Anabaena, Nostoc and Tolypothrix, you know that Anabaena azollae is an important algae which is responsible for synthesizing atmospheric nitrogen or, we know, fixing atmospheric nitrogen in the rice field and these are also very very helpful and very very important from the agricultural point of view.

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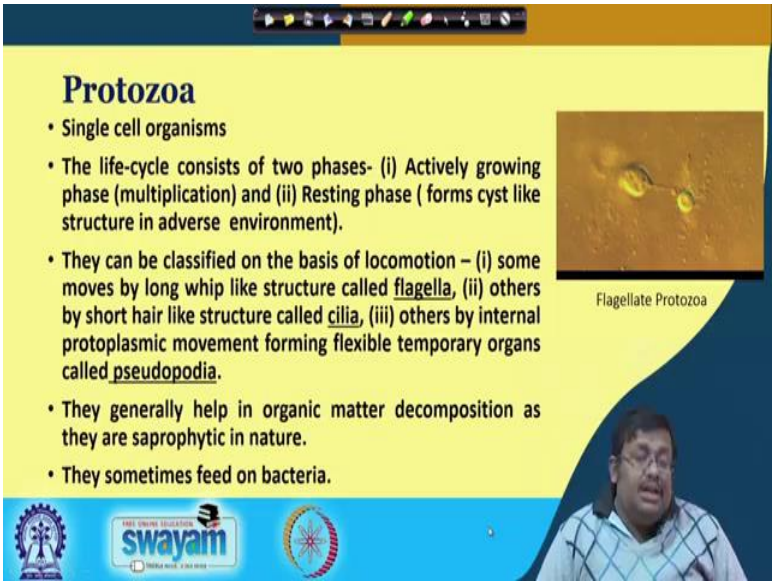

Now, next important let us talk about the soil micro fauna, protozoa let us talk about protozoa. They are basically single cell organisms however the life cycle consists of 2 phases; one is the actively growing phases that is multiplication and secondly the resting phase, that is where they form cyst like structure in adverse environment to protect themselves and they can be classified on the basis of the locomotion.

So, some moves by long whip like structures like called they are called flagella and others by short hair like structure called cilia and others by internal protoplasmic movement forming flexible temporary organs call pseudopodia. So, these, you know, based on these, they, you know, they are classified, so you can see in the right side there is a flagellated protozoa you can see and they generally help in organic matter decomposition as well as because they are saprophytic in nature and also they can feed on bacteria and maintain biological equilibrium in the soil.

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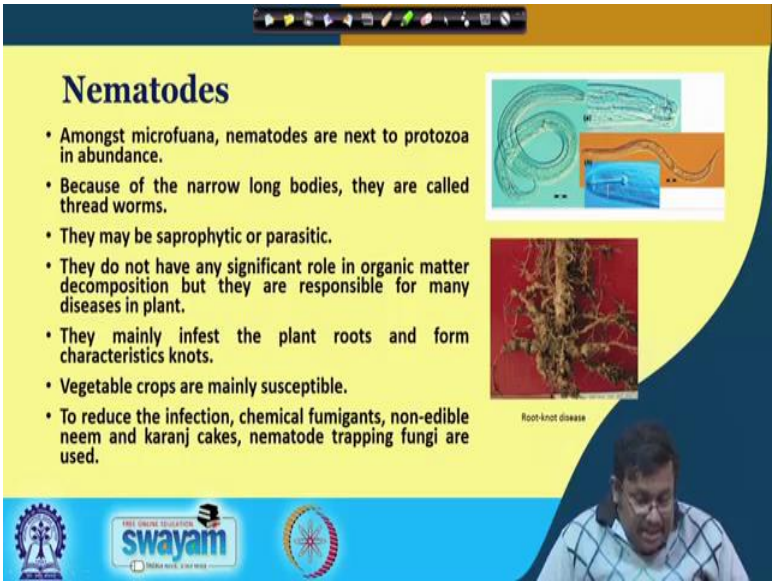

The next important microfuana are Nematodes and among these are and they are they are they are next to protozoa in abundance and because of the narrow long bodies, they are also called threadworms in this and they are, you know, they may be saprophytic or parasitic in nature.

So, they do not have any significant role of organic matter decomposition, but they are responsible for many diseases in the plant as we can see here, they are some, these are some nematode which are present in the plant and this is one of the major plant disease called root knot disease which is created by this nematode and they mainly infest the plant roots and form this characteristic knots in the roots and most of the time vegetable crops are mainly susceptible for this type of nematode attack and to reduce the infection, different types of chemical fumigants and non edible Neem and Karanj cakes and, you know, nematode trapping fungi are basically used.

So, basically nematodes does not have any, I would say, a beneficial effect on soil, they are mostly, you know, parasitic and they mostly create some diseases in the plants. So, we need to take care of these nematodes and we need to eradicate the nematodes for the better growth of the plant in the soil.

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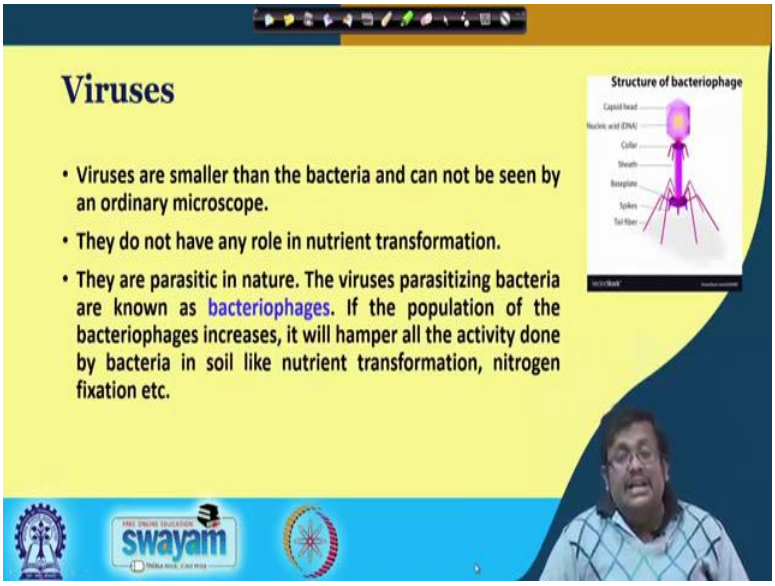

Last one is the Viruses, now viruses are the smaller than that a bacteria and cannot be seen by ordinary microscope and they do not have any role in the nutrient transformation only they are parasitic in nature and these virus which basically parasitizing bacteria known as bacteriophages you know that from your plus 2 knowledge. And if the population of the bacteriophages increases it will hamper all the activity done by bacteria in soil like nutrient transformation nitrogen fixation etcetera.

So, this is a structure of bacteriophage you can see their capsid head which contains the nucleic acid or DNA and then followed by collar and sheath and then base plates and then spikes and tail fibre. So, this is a structure of a bacteriophage. Viruses are also very much abundant in the soil. So, guys we have completed these soil organism lecture and let us go ahead and start another important topic or the last topic of this week that is compost.

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So, what is compost, compost is basically an end product of composting. So, what is composting you can ask. So, composting is a basically decomposition of plant remains I would say control decomposition of plant remains and other once living animal materials to make an earthy, dark, crumbly substance that is called compost and that is excellent for adding in house plants for enriching garden soils.

So, this compost is basically a, you know, it is decomposed organic matter which contains high amount of nutrient and people generally use this compost for their, you know, everything different types of garden crops and, we know, different types of vegetables and there are several types of composting methods and composting is one of the major soil organic manure.

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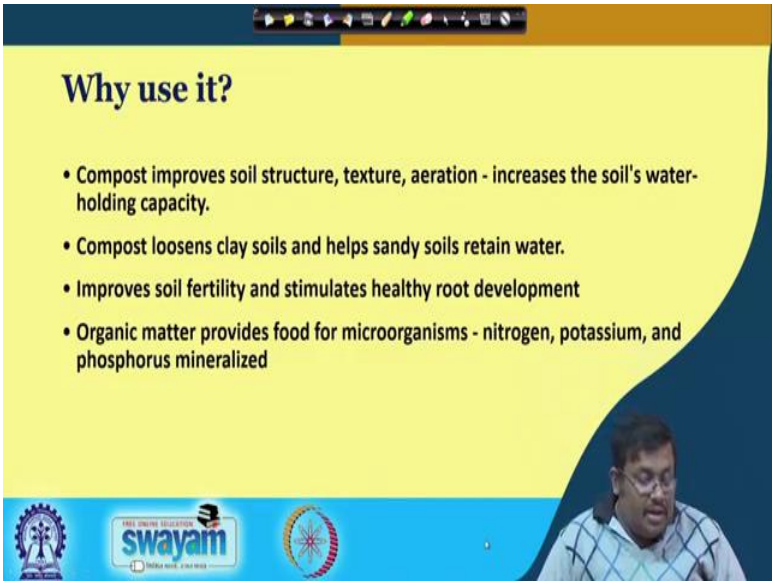

Now, why we should use the compost the question may come. Now first of all, since it is a high amount of organic it is a another it is a basically an organic matter which we are basically adding into the soil, compost improves the soil structure, texture and aeration and it increases the soil water holding capacity.

Obviously, since they are having high amount of organic matter, they are increasing the soil structure and their aggregates and also their aeration by improving the soil structure and also they are improving the soil water holding capacity. Because, you know that organic matter contains huge amount of micro pores which can hold a huge amount of water and also compost loosens clay soils and help sandy soils to retain water.

So, if we add some compost into the sandy soil, the water holding capacity of the sandy soil will increase, whereas if we add organic matter into the compost into the clayey soil which is hard in nature, it will loose it down and it will help in better water movement and air movement.

So, this is the benefits of using compost into the soil and also it improve soil fertility and stimulates healthy root development and organic matter which is present inside the compost provide foods for microorganisms like nitrogen, potassium and phosphorus mineralised. So, these are a, you know, several advantages of using compost which we should take care.

You know, take into consider consideration and that is why nowadays in all the countries this application of compost is highly recommended and it is also environmental friendly and for I would say for any integrated nutrient management practices now a days, the application of compost is recommended along with the chemical fertilizer for maintaining the environmental sustainability.

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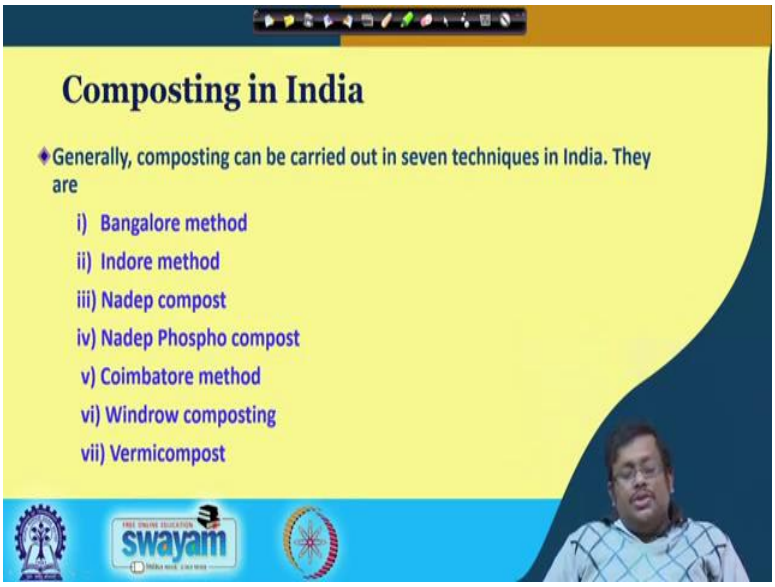

So, let us talk about composting in India, now generally composting can be carried out in 7 techniques in India and they are basically listed here. One is Bangalore method and then another is Indore method, then Nadep compost, then Nadep phospho compost, then Coimbatore method, then windrow composting and vermicompost.

Now in this lecture we will be covering only Indore method, Nadep compost and vermicompost because these are important in India and also Bangalore method and we know Coimbatore method is important. However, we will not have time to discuss those in details, but if you are interested you can go ahead and search some literature which will discuss in the those in details. So, let us start with the Indore method.

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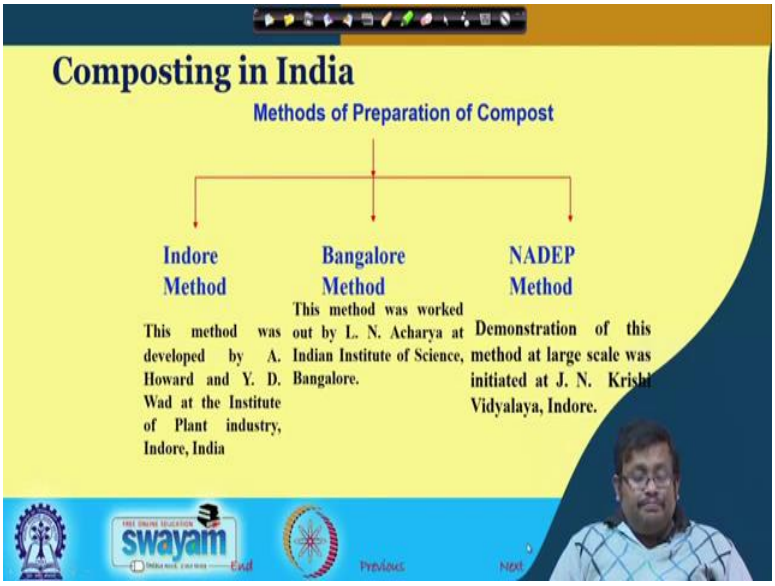

So, but before that before discussing Indore method in details, let us see who develop this methods. So, this Indore method was developed by A. Howard and Y.D. Wad at the institute of plant industry that is in Indore, India. So, that is why this method is known as Indore method and Bangalore method was worked out by L.N Acharya at Indian institute of science, Bangalore and Nadep method was, you know, first demonstrated by this, you know, at this J.N. Krishi Vidyalaya at Indore. So, these are 3 important methods of composting in India.

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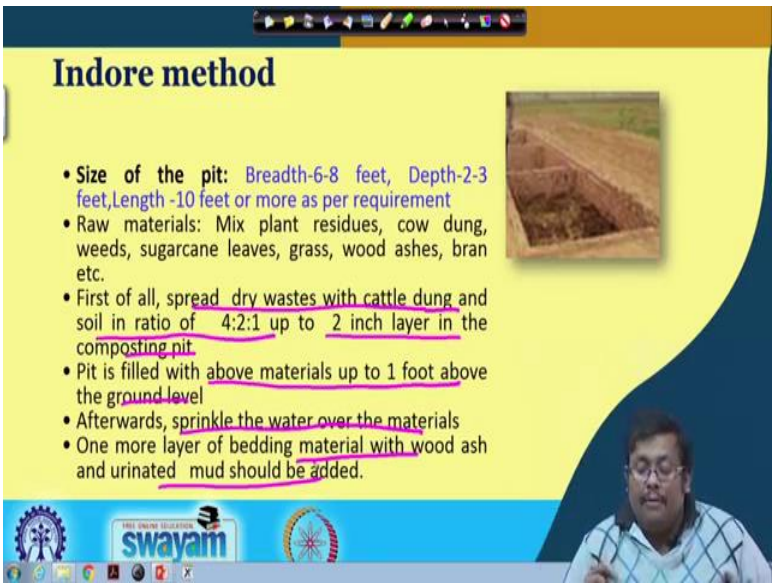

Now, let us start with the Indore method. Now in case of Indore method the pits will look like this. So, you have to create the pits and size of the pits will be the breadth will be 6 to 8 feet depth will be 2 to 3 feet it should not be more than 2 to 3 feet and length should be 10 feet or more as per the requirement.

So, what are the raw materials we generally use in case of Indore method? Mix plant residues generally use, we also use cow dung, we also use weed, sugarcane we also use urine, soap, mud and grass and wood ashes, bran etcetera. So, these are the materials which we use as the raw materials in Indore method of composting. So, let us see how we can create this Indore method of Indore compost.

So, first of all we have to spread dry leaves with cattle dung and in soil in the ratio of 4 is to 2 is to 1 up to 2 inch layer in the composting pit. So, this is a first layer and pit is filled with above material up to 1 foot above the ground level ok. Now after that once it reaches the one foot above the ground level, then we have to sprinkle the water over the materials and 1 more layer of bedding materials with wood ash and urinated mud should be added. So, this is how it is created layer by layer and we can go up to 1 feet above the ground.

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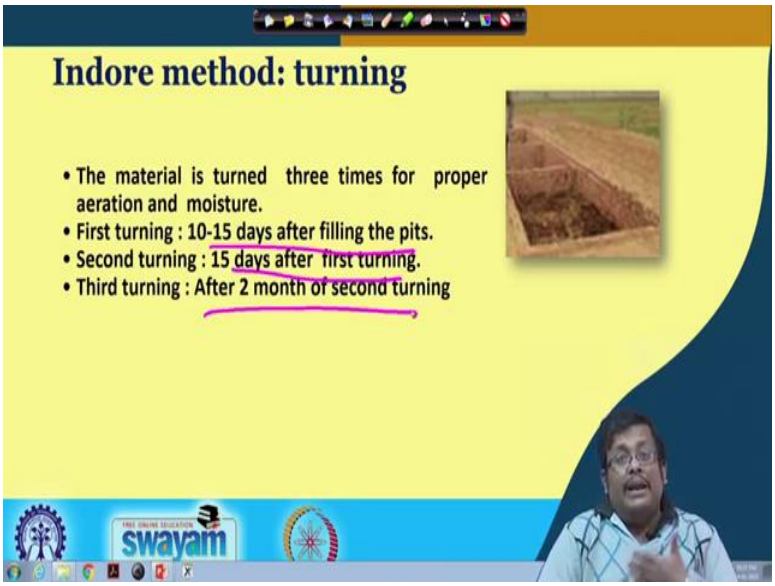

So, after we place the compost for decomposition, we need to give some turning, now turning is required for proper aeration and moisture. So, you can see the material for proper aeration and moisture and we required at least 3 turnings. So, first turning is

basically given at 10 to 15 days after filling the pits and second turning is given 15 days after first turning and the third turning is given basically after 2 months of second turning. So, these turnings are necessary for proper aeration and moisture and proper formation of compost, so this is about the Indore method of composting.

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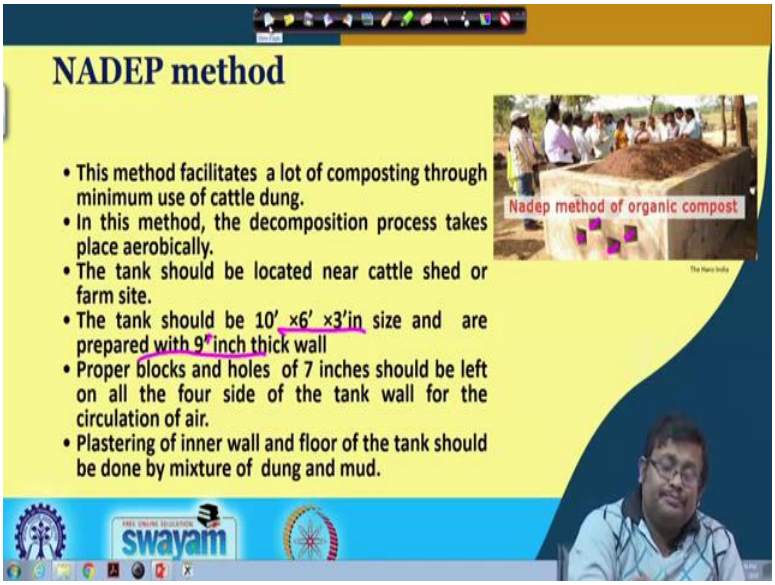

Now, let us talk about Nadep method, now this method facilitates a lot of composting through minimum use of cattle dung and in this method the decomposition process takes place aerobically and the tank should be located near the cattle shed or farm site and important is the tank should be 10 feet by 6 feet by 3 feet in size and are prepared within 9 feet in 9 inch thick wall. So it should be 9 inch thick wall.

So, proper blocks and holes of 7 inch should be left on all the 4 sides of the tank valve for the circulation of air. So, you can see this an example of Nadep compost bed and you can see all the holes are created for proper aeration and circulation of air and plastering of inner wall and floor. So, the tank should be done by mixing of dung and mud so this is very very important. So, this is how we create a Nadep compost pit and again remember this method was first demonstrated in J.N. KV in Indore.

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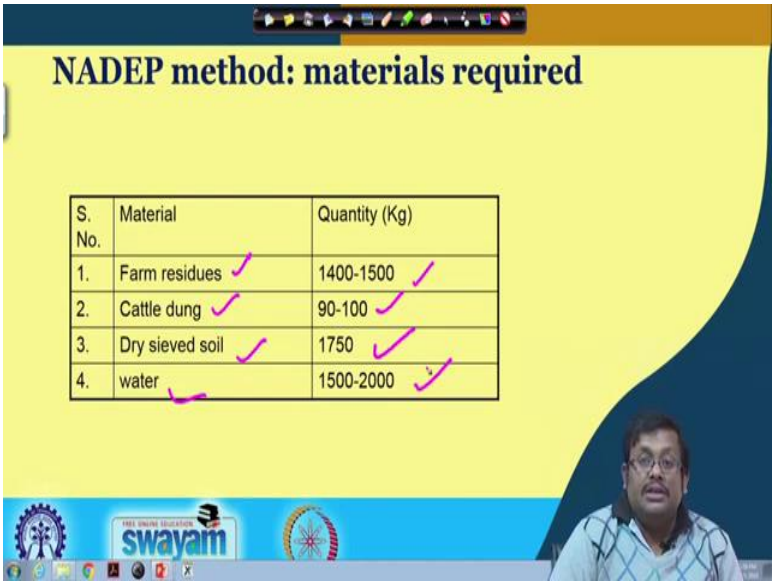

So, in case of Nadep methods these are the materials which are required, first of all we require farm residues because it, you know, in the previous slide you have seen that we should make this pit near the farm. So, farm residues will be used as an important raw material for this Nadep compost. So, we require 1400 to 1500 kg of farm residue we require cattle dung of 90 to 100 kg, we require dry sieved soil of 1750 kg and then water in 1500 to 2000 litre. So, these are the raw materials which we require for this Nadep compost.

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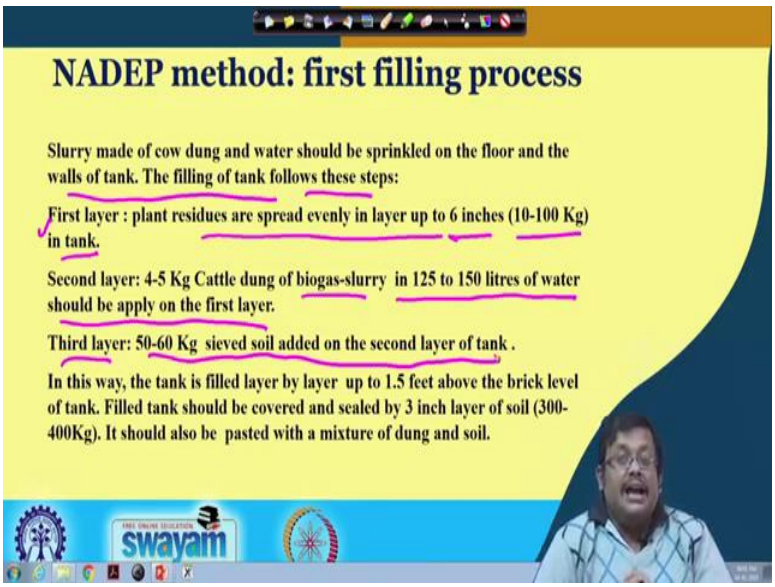

So, what are the filling process? So, there 2 at least 2 filling processes. So let us talk about the first filling process in case of Nadep compost. So, first of all slurry made of cow dung and water should be sprinkled on the floor and the walls of the tank and the filling of the tanks follows this following steps.

So, first layer obviously plant residues are spread evenly in layer of 6 inches that is 10 to 100 kg in the tank and second layer 4 to 5 kg cattle dung of biogas slurry in 125 to 150 litres of water should apply on the first layer and in the third layer 50 to 60 kg of sieved soil added on the second layer of the tank.

So, again in the first layer will be produce will be will be will be applying plant residues and we will be spreading the plant residues evenly in layer up to 6 inches and then in the second layer, we will add 4 to 5 kg of cattle dung of biogas slurry in 125 to 150 litre of water and applied in the over the first layer and in the third over that in the third layer, we will add 50 to 60 kg of sieved soil in the over the second layer of the tank. So, in this way the tank is filled layer by layer up to 1.5 feet over the above the brick level of the tank. Now this filled tank should be covered and sealed by 3 inch layer of soil that is 300 to 400 kg and it should be pasted with a mixture of dung and soil.

So, if you go back and see the previous slide where I have shown you, so this is the plastering you can see at the top with cow dung and soil mixture which is required for this Nadep method. So, you spread all this required raw materials in layers by layers and after that once it reaches a required depth after the over the bricks of the tank, then you plaster it through the mixture of soil and this cow dung. So, this is basically the process of first filling.

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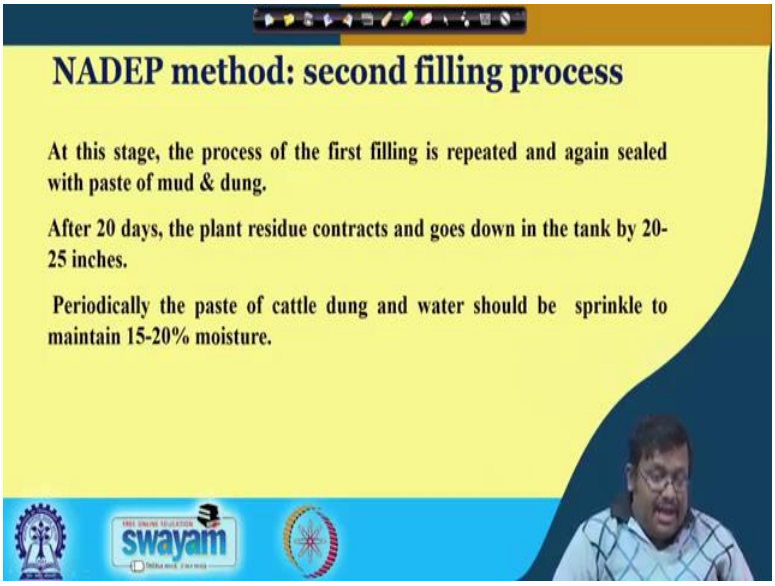

Now, what is the process of second filling? At this stage, the process of the first filling is repeated again and sealed with paste of mud and dung. So, after 20 days the plant residues contracts and goes down in the tank by 20 to 25 inches, obviously because when the decomposition will go on. Obviously, there will be reaction in the volume and reduction in the weight and periodically the paste of cattle dung and water should be sprinkled to maintain the 15 to 20 percent of the moisture. So, this is the method of second filling in case of Nadep method.

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So, guys we have completed these 2 methods important methods; obviously, the other methods are Bangalore method and Coimbatore method you can you can consult some literature to search in details about those methods. But let us talk about very important process that is vermicomposting. A vermicompost also called worm compost or vermicast or worm casting or worm humus or worm manure.

So, there are several names for this, we know, compost is basically end product of the breakdown of organic matter by some species of earth worm. Basically the epigeic earth worms. So vermicompost is a nutrient rich natural fertilizer and soil conditioner. It improves the soil physical chemical and biological conditions. So the process of producing vermi composting is known as vermi I am sorry. So, the process of producing vermi compost is known as vermicomposting.

The earthworm species or composting worms most often are, you know, brandling worm. So, also known as Eisenia foetida, it is a most important worm or sometime red wigglers like Lumbricus rubellus and also Perionyx excavates, Eudrilus eugenie. So, these are some common, you know, common species of earth worm which we use for producing the vermi compost. So, now, you can see this is vermicompost and how we produce the vermi compost we will see in the next slide.

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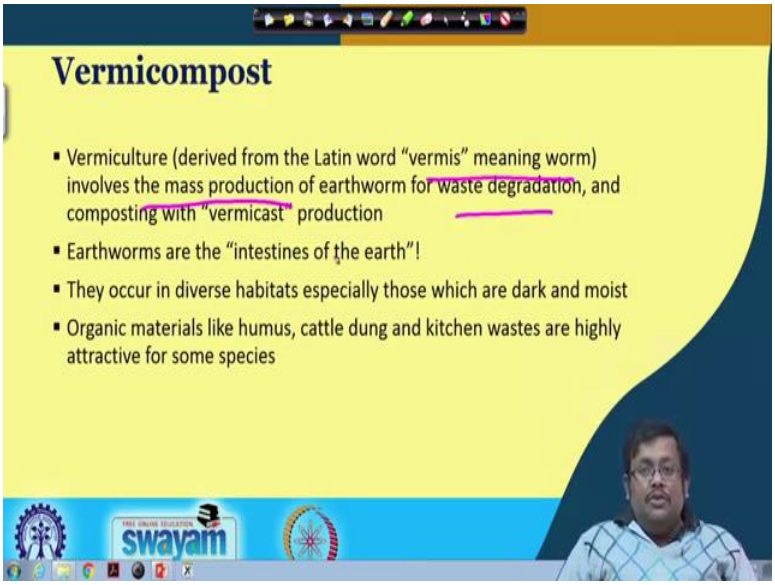

So, vermi culture which is derived from the Latin word vermis meaning worm and it involves the mass production of earthworm for waste degradation and composting with

vermicast production. So, earthworms remember they are the intestines of the earth. Vermi comes from the, you know, vermi means worm and it involves this vermiculture means the mass production of earth worms for waste degradation.

So, they occur in diverse this earth worms occur in diverse habitats especially those which are dark and moist areas and organic material like humus, cattle dung and kitchen waste are highly attractive for some species. So, they ingest those materials some amount they, you know, retain for their own biomass creation and they convert the other. you know, remaining portion and they just excrete it out and that is a very very huge source of nutrient. So, this is called the vermicompost.

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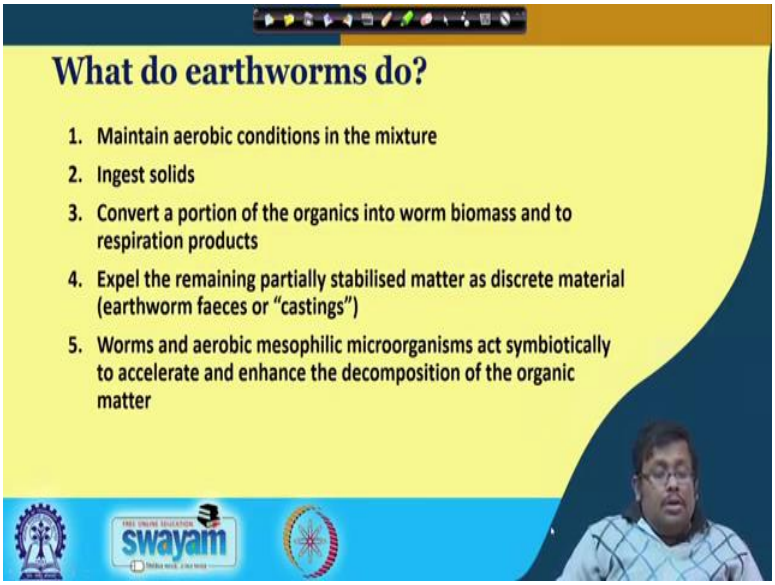

Now, what actually these earth worms do, so they basically maintain the aerobic condition in the mixture. So, basically they ingest soil and convert a portion of the organics into the worm biomass and to respiration and to respiration products and expel the remaining partially stabilized matter and discrete material we call it castings and these are basically the worm cast or vermicompost.

So, worms and aerobic mesosphilic microorganism act symbiotically to accelerate and enhance the decomposition of the organic matter. So, that is how this is another form of worm compost and this compost we shall add to different for encouraging the growth of the different plants.

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So, what are the properties important properties beneficial properties of the vermicompost, well they are very finally structured, uniform stable and aggregated particles of humified organic material. And they have excellent porosity, aeration and water holding capacity and they are rich in available plant nutrients and hormones, enzymes and microbial populations. And they are mostly pathogen free because, plant and human pathogens are killed during the passage of the earth worm gut and earth like soil building substances that forms a building a beneficial growing environment within the in the for plant roots and their these vermicompost are valuable and marketable products.

So, again these if we apply this vermicompost into the soil, they improve the soil aggregation, they have excellent they increase the porosity, they increase the aeration, increase the water holding capacity all these are beneficial in nature. Also they are rich in plant nutrients which helps in, we know, a proper growth of the plant, they secretes some hormones, they secrets enzyme for degradation of organic matter or conversion on or the nutrient transformations, they are pathogen free.

Another good thing about this vermi compost they are, you know, they are virtually odour free, so these are very good I mean they are not producing any odour. So, plant and human pathogens are also killed because, we know, they are moving through the guts of the earthworms and the you can sell this products it is a very very valuable and

marketable product because, these are very very attractive things for gardening and the, you know, vegetable crops.

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So, this is the vermicompost pit, basically vermicompost can be done, you know, vermicompost are developed in the shady area. So, basically we develop the pits you can see here using different materials, you can see you can you can create these vermicompost, we know you know, vermicompost pits using some mud, using bricks and within these vermicompost pit, you can basically spread layers of different materials.

Basically you can add farm residues or kitchen wastes and then you can add a slurry of cow dung as well as water and after that, you can further add another layer of these a farm residues and all these things and after that, you know, after that these earth worms are released here in these vermi beds and we have to create a uniform moisture condition and they are basically covered through some, you know, moist bags to maintain the moisture condition. And after a certain period of time these microorganisms will ingest this materials and ultimately they will convert these materials into vermi compost which can be further sieved and, you know, further it, you know, once this material will be produced they will be dark in colour, they will be odour free and basically they will be harvested and then sieved pact in the as a final product.

So, this is a vermi composting product guys. So, you can search some several materials or literature which are we which talks about this vermi casting composting process.

There are different processes of vermicomposting, but obviously one thing is common. All of them are using different, you know, all of them are using the, you know, earthworms for production of vermicompost and these vermicomposts are very very beneficial for the growth of the plant.

And so guys there are other also different other types of compost like kitchen compost you can you can you can search some literature about those thing and there are some available bio digesters which are now available which you can use in your home to produce your, to produce the compost for your own kitchen garden, because each and every day the kitchen waste which are generated we can recycle those kitchen waste into the one, you know, in inside those bio digester to produce the organic compost.

So, the, you know, composting is a very very interesting process and these composting process is very very environmental friendly guys and these are also very very beneficial. So, it is a very important waste management practices solid waste management practice.

So, let us wrap up the week 8 lectures here I hope that you have learnt something new in this week and we have covered several important topics like soil testing, like, we know, organic matter, like macro and micro organism, then composting, then vermicomposting all these are important topics I hope that you have got some basic overview of these important topics. And if you are interested please feel free to email me to learn in details or you can go ahead and search some literature to gain further knowledge.

Thank you very much and in the next lecture we will be starting the week 9 of lectures.

Thank you very much guys.