Soil Fertility and Fertilizers
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Lecture: 37
Organic Manures, Manufacturing, Properties, and Fate of N, P, K and Micronutrient Fertilizers (Contd.)

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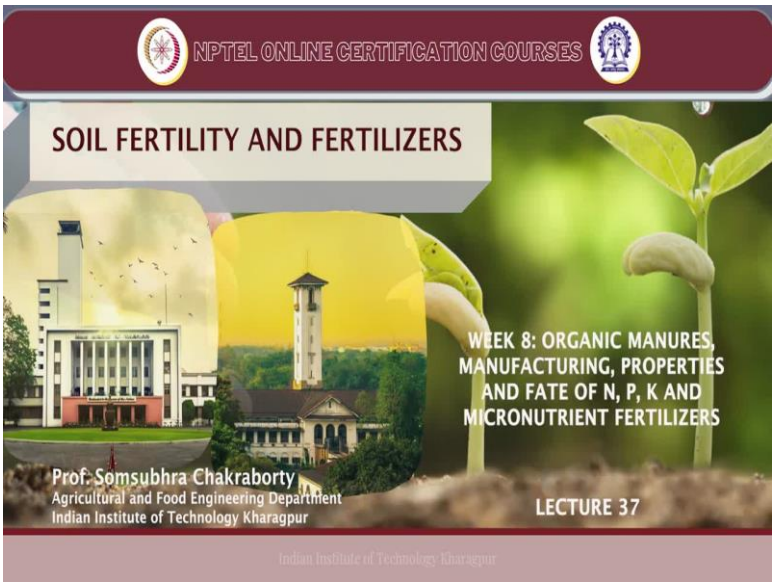

Welcome friends to this second lecture of week 8 of this NPTEL online certification course of Soil Fertility and Fertilizers. In this week, we are discussing about organic manures and we are also discussing about their properties, their fate and different macronutrient and micronutrient fertilizers.

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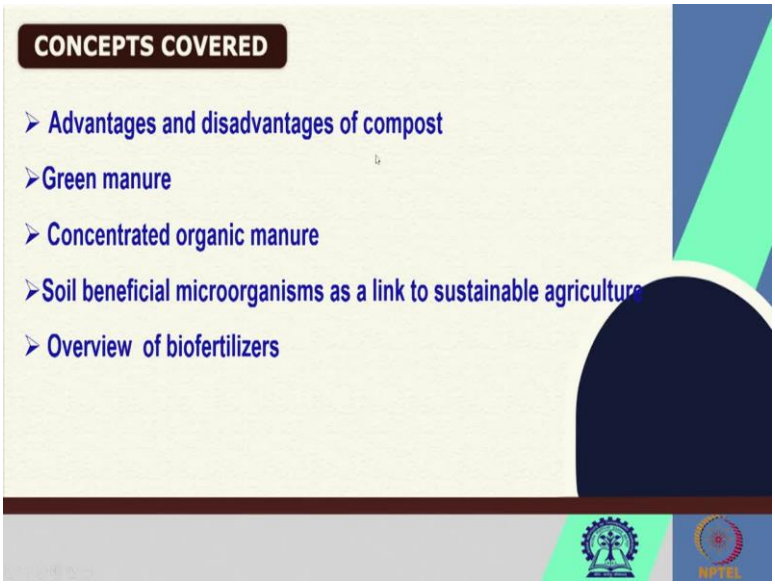

So, in this 37th lecture, we are going to discuss these following concepts, advantages and disadvantages of compost, then green manure, then concentrate organic manures, then soil beneficial microorganisms as a link to sustainable agriculture and a very basic overview about bio fertilizers. So, these are the concepts which we are going to discuss.

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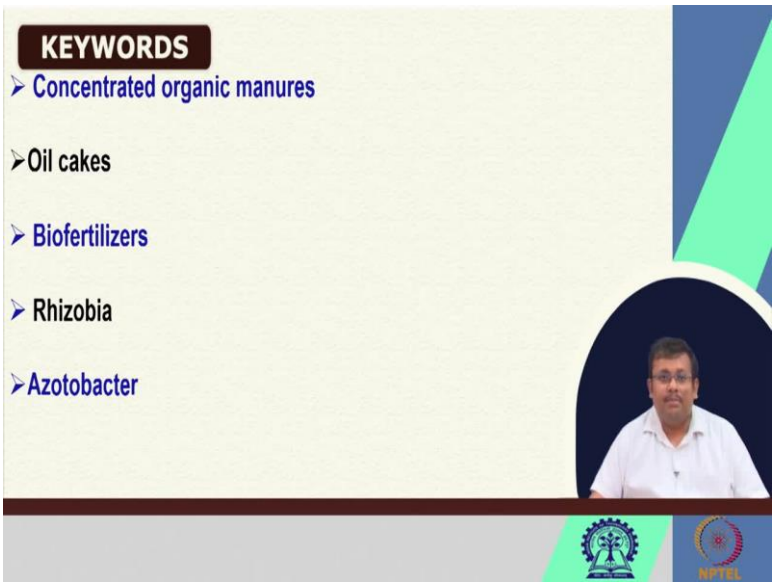

Now, in the previous lecture also we have discussed about compost and we are going to we are going to continue from there and these are some of the keywords considered organic manure, oil cakes, biofertilizers, Rhizobia, Azotobacter so, these are some of the keywords for this lecture.

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So, guys in our previous lecture we have discussed about composting, composting is a process is a microbial mediated process in which organic matter from different sources are converted or decomposed into a manure which we can apply to the field so, that it can improve not only the soil physical, but also soil biological and chemical properties also and thereby increasing the soil productivity as well as fertility.

We have also discussed the different methods of compost formation like we have discussed about Coimbatore method, we have discussed about Bangalore method, we have discussed about Indore method of composting and we have also discussed about NADEP method of composting. These are the methods, these methods are deferred based on the arrangement of layers during the composting process and they are composting time.

So, now the next question comes to our mind what is the need for composting? Why we should go for composting? Composting is a bulky, compost is a bulky organic manure just like farm yard manure, however why we nowadays see people are support, people are talking about composting process, what is a need for composting?

Now, the first important need for composting is the rejected biological materials contain complex chemical compounds such as lignin, cellulose, hemicellulose, polysaccharides, proteins lipid et cetera and these complex materials cannot be used as such as resource materials. So, they need to be converted into simple inorganic elements as available nutrients unless these complex chemical compounds like lignin, cellulose hemicellulose are converted into simple inorganic element as available element or available nutrient. Plant cannot grow or they cannot be used as a resource material as such.

So, the materials put into soil without conversion will undergo conversion inside the soil and the conversion process takes away all energy and available nutrients from the soil and affecting the crop. So, the conversion period is mandatory. So, instead of composting if you put into the soil during the conversion process there is some loss. So, in the composting process, these loss is minimized and the nutrient contents are maintained.

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And also, there are other advantages like volume reduction of waste. So, whenever you have huge amount of waste, you need to reduce the volume. Composting can help you to reduce the volume of the waste. Then final weight of the compost is also very less. Composting temperature can kill pathogens, weed seeds and also the other harmful seeds.

So, during the composting you will see that some processes are hypothermic in nature and as a result they can kill the pathogen and harmful weed seeds and other seeds. Matured compost comes into equilibrium with the soil. So, when you apply these matured compost in the soil, they establish an equilibrium with the soil.

During composting a number of waste from several sources are blended together as I told you that for composting, we require agriculture waste we require soil we require water we require cow dung and several other things. So, you can see that during the composting process waste from several sources are basically we are blending together.

Composting access excellent soil condition and it improves the soil physical condition is nothing but in organic methods, so, when we apply it immensely improve the soil fertility properties, soil chemical properties or buffering capacity and also soil physical properties. It is a sellable product. So, you can sell it to earn money.

It improves composting can help improving manure handling and it reduces the risk of pollution and it reduces the pathogen and it helps in generating the additional revenue. So, these are some of the advantages of composting and how it can improve the soil fertility and productivity.

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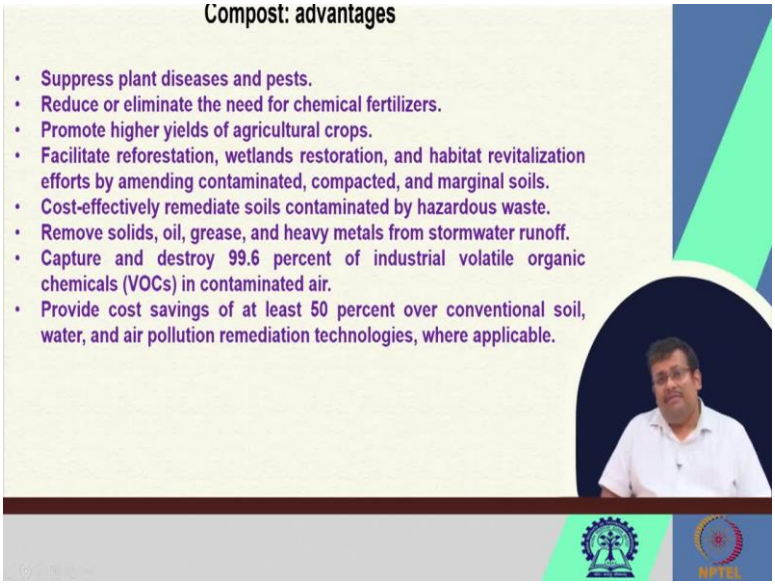

Other advantages of compost is compost can suppress the plant diseases and pests. It can reduce or eliminate the need for chemical fertilizers. It can promote higher yields of agricultural crops of course, improves the productivity. It facilitate compost can facilitate reforestation wetlands restoration and habitat revitalization effort by amending contaminated compacted and marginal soils.

So sometime in the marginal soils we can apply compost to facilitate the reforestation, wetland restoration and habitat revitalization and composting is a cost-effective way to remediate soils contaminated by hazardous waste and it can remove solids, oil, grease and heavy metals from storm water runoff.

It can capture and destroy 99.6 percent of industrial volatile organic chemicals in contaminated air and it can provide cost savings of at least 50 percent over conventional soil water and air pollution remediation technologies wherever applicable. So, these are the several advantages of compost.

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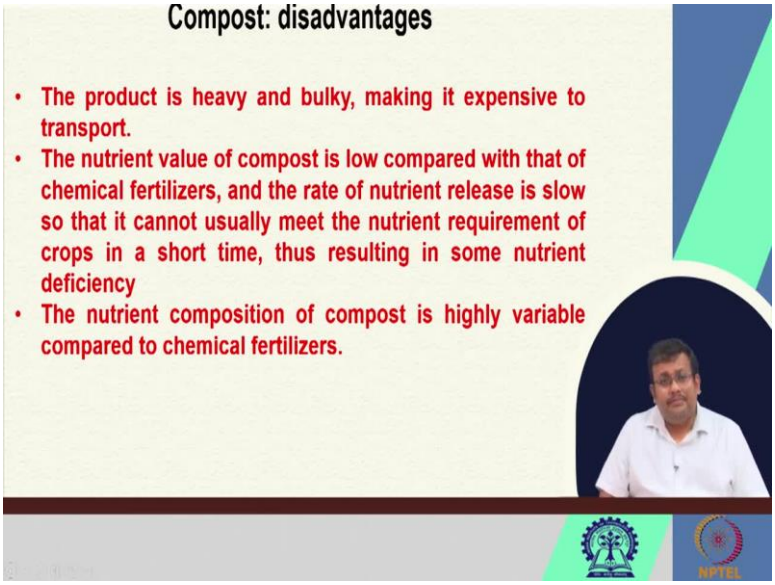

But at the same time compost is also having several disadvantages what are these? So, first of all the product is heavy and bulky and making is expensive to transport. So, if you consider if you considered the chemical fertilizers still as compared to the chemical fertilizers, the product is heavy or bulky. So, if we compare the transport of chemical fertilizer and transport of compost, of course, compost transporting is expensive.

The nutrient value of compost is low compared with that of chemical fertilizer and since it is a bulky organic manure of course, their nutrient value will be low as compared to the chemical fertilizers and the rate of nutrient release is slow so that it cannot usually meet the nutrient requirement of crops in a short time.

Thus, resulting in some nutrient deficiency. Compost itself cannot usually meet the nutrient requirement in a short time. So, that is why for correcting, immediately correcting the fertility or the nutrient deficiency, people generally rely on Chemical fertilizer, the nutrient composition of compost is highly variable compared to chemical fertilizers. So, depending on different sources, compost are named differently and of course, their composition is also different.

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Another disadvantages agricultural users might have concern regarding potential levels of heavy metals and other possible contaminants in compost particularly mixed municipal solid waste. So, the potential for contamination becomes an important issue when compost is used on food crops. In India, we have seen that when composting materials are applied when we develop the compost from some dumping sites soil and those composted materials are applied to the field that can increase the heavy metal concentration in the soil.

So, this is one of the major point of concern for compost application specifically the municipal sub those compost which are made from municipal solid waste apart from that long term and heavy application of compost to agricultural soils has been found to result in salt, nutrient or heavy metal accumulation and may adversely affect plant growth, soil organisms, water quality and animal and human health. So, these are some of the disadvantages of composting.

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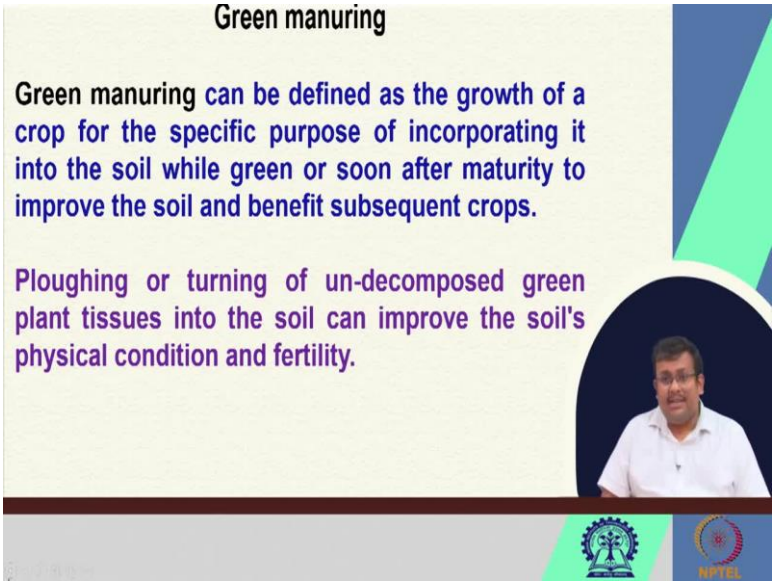

Another method which we are going to discuss is called Green manuring method. Now, green manuring can be defined as a growth of a crop for the specific purpose of incorporating it into the soil while green or soon after maturity to improve the soil and benefit the subsequent crop.

So, green maneuvering means when the crop is we generally mix these crops we say we generally grow these crops in the field and generally mix them in the soil when they are still green to improve the soil, physical chemical and biological properties and to benefit the subsequent crops. Now, plowing or turning of undecomposed in plant tissues into the soil can improve the soil physical condition and fertility.

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So, this is how green manure works. Now, the objectives of green manuring are first of all to increase the organic matter content in the soil, when you are mixing the plant in the soil, remember that all the plant parts these are basically composed of different complex organic compounds and these organic compounds are like cellulose hemicellulose. So, when we incorporate the green manure in the soil that can increase the organic matter content of the soil.

Secondly, they can maintain and improve the soil structure of course, that way we add organic matter that can improve the soil structure by helping in the aggregation process and it reduced the loss of nutrients particularly nitrogen it provide a source of nitrogen for the falling crop some of the crops or some of the green maturing crops and known to fix the atmospheric nitrogen to biological nitrogen fixation and thereby they improve they provide the nitrogen for the subsequent crop and also finally, it can reduce the soil loss by erosion using by adding the organic matter and through their root system. So, these are some of the objectives of green manuring.

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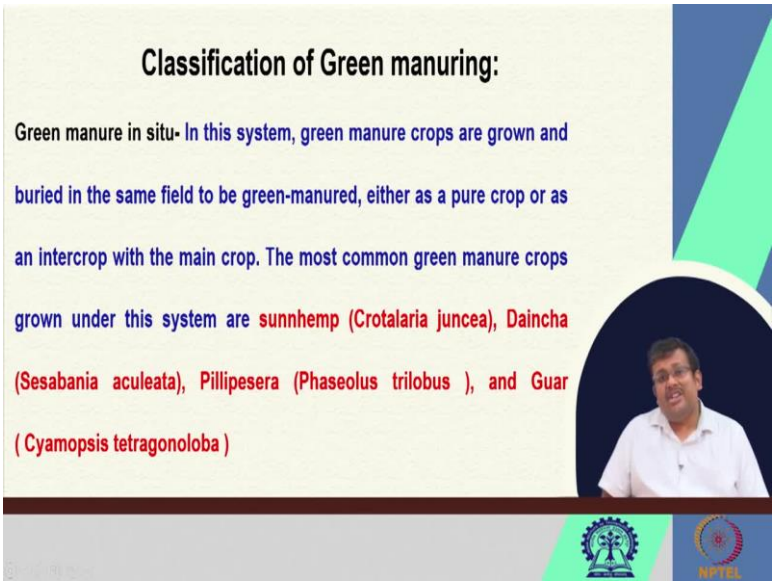

Now, let us see the classification of the green manuring, the first category of green manuring is green manuring in situ. So, in this system green manure crops are grown and buried in the same field to green manure to be green-manured and either as a pure crop or as an intercrop with the main crops.

So, basically in this case we are growing the crop in the field and just before the sowing of the next crop, we are incorporating that we are harvesting and incorporating that standing

crop in the field to face it and facilitate the decomposition. So, this is called Green manuring in situ, so the most common green manure crops grown under these systems are Sunnhemp, Daincha or Sesabania and also Phaseolus and Guar. So, these are some of the important plants which you can grow for in situ green manuring.

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Another method is called Greenleaf manuring. Now, the green leaf manuring refers to the turning green leaves and Tinder tweaks collected from shrubs and trees grown on bunds, waste land and nearby forest area into the soil. So, you collect these green leaves and tender twigs from the nearby areas and you apply into the field.

So, the common shrubs and trees are Glyricidia, Karanj et cetera, plants used as a source of green leaf manure or Azolla, then Calotropis, then Cassia, so these are required for green leaf manure. So, here leaf is considered as a major part for manuring. So, these are the 2 major categories of green manuring.

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Now, here you can see green manure crop cover can reduces the need for mineral fertilizer, especially when you grow the pulses, when you incorporate the pulses as a green manure, so, that can incorporate a pulse as a leguminous type of crops which can fix the atmospheric nitrogen can reduce the nitrogen requirement in the subsequent crop.

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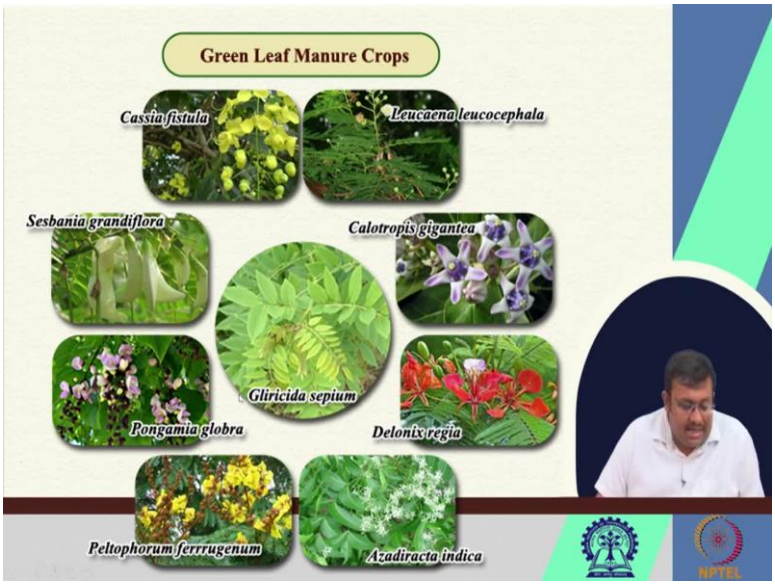

So, these are some of the Greenleaf manure crops like Cassia, Sesbania, Pongamia, then Peltophorum, then Azadiracta neem, then Delonix, then Calotropis, then Leucaena Leucocephala, so, these are some of the green manure crops.

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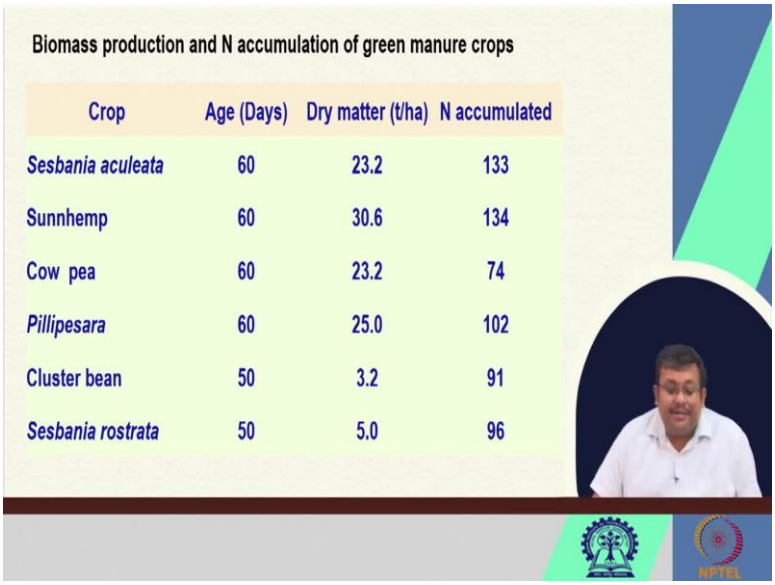

Now, let us see the biomass production and Nitrogen accumulation of green manure crops. So, if you see the Sesbania aculeate in 60 days, it can produce a diameter of 23.2 tons per hectare and it can accumulate huge amount of nitrogen also Sunnhemp can also incorporate huge amount of nitrogen cow pea then Pillipesara, then cluster bean, Sesbania rostrata, all these can also incorporate huge amount of nitrogen.

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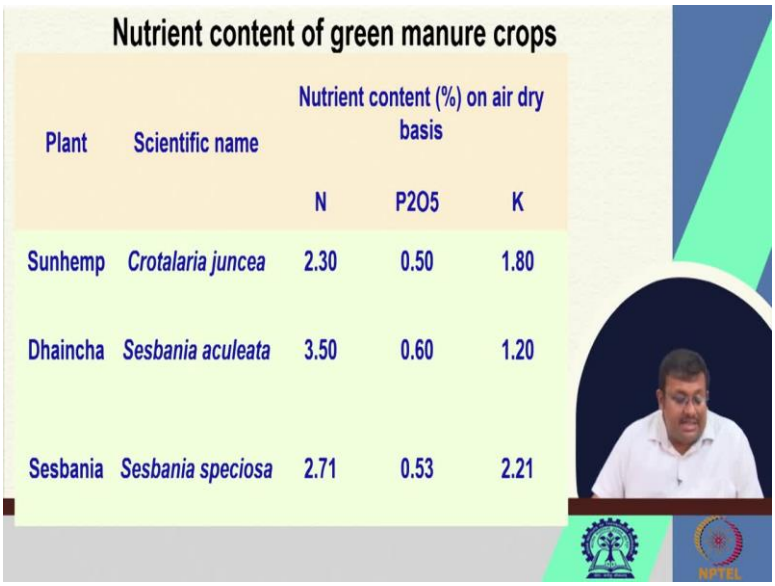

If you see the other plant in person bases in Sunhemp content, that is crotalaria juncea content 2.3 percent nitrogen, 0.5 percent P 2O5 and 1.8 percent potassium in case of Dhaincha or Sesbania aculeate, it contains 3.5 percent nitrogen, 0.60 percent of P 2O5 and 1.20 percent of

K in case of Sesbania, it contains 2.71 percent of nitrogen 0.53 percent of P2O5 and 2.21 percent of potassium.

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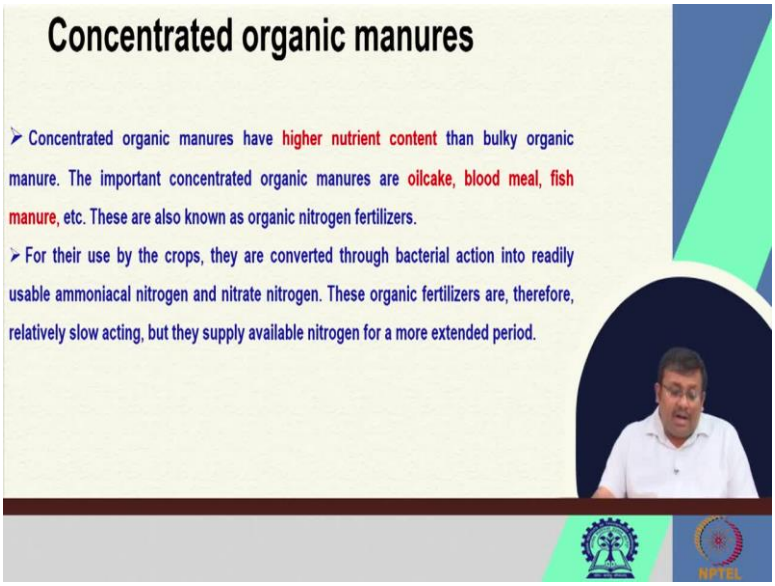

So, these are the green manure and let us now discuss the second most important thing that is concentrated organic manure, we have discussed about the bulky organic manure. Now, let us discuss about the concentrator organic manure. Now, concentrated organic manure have higher nutrient content than bulky organic manures and the important concentrate organic manures are oil cake blood meal fish manure et cetera.

These are also known as organic nitrogen fertilizers. So, for that used by the crop they are converted to bacterial action into readily usable ammoniacal nitrogen and nitrate nitrogen and these organic fertilizers are there for relatively slow acting, but they supply available nitrogen for a more extended period. So, let us see what are the important of concentrator organic manure?

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Let us first discuss this oil cake. Now, after the oil is extracted from the oil seeds the remaining solid portion is dried as a cake which can be used as a manure. Now, as I have already discussed at the beginning the oil cakes are of 2 types. One is edible oil cakes which can be safely fit to the livestock example groundnut cake coconut cake et cetera. The second one is non-edible oil cakes which are not fit for feeding the livestock. Examples are Castor cake, Neem cake, Mahua cake et cetera.

Now, remember that both edible and non-edible oil cakes can be used as manure or however edible oil cakes are fed to cattle and non-edible oil cakes are used as manures, especially for horticultural crops. Nutrients present in oil cake after mineralization are made available to crops 7 to 10 days after application because they have very less CN ratio. So, their mineralization is quite fast. Oil cakes needs to be well powdered before application for even distribution and quicker decomposition.

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Now, these are 2 oil cakes, one is groundnut cake and other is mustard cake. These are of course, as you can see, these are edible oil cakes.

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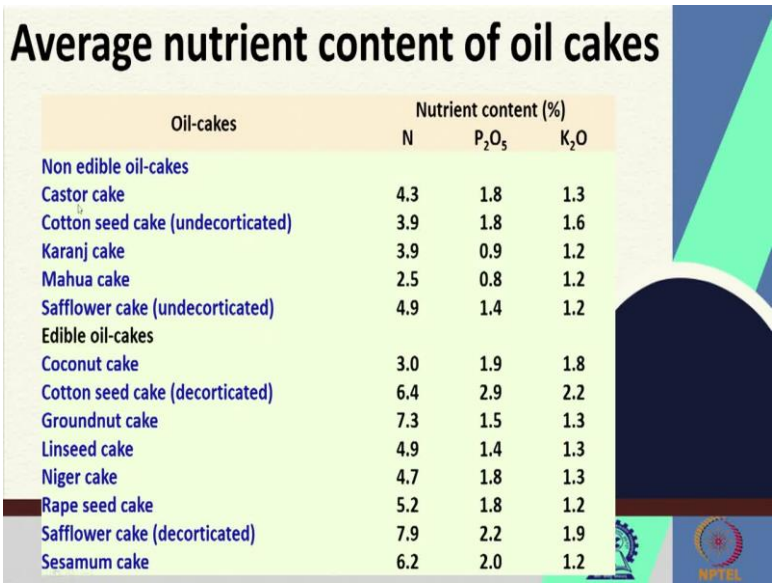

Oil-cakes	Nutrient content (%) N	P_2O_5	K_2O
Non edible oil-cakes			
Castor cake	4.3	1.8	1.3
Cotton seed cake (undecorticated)	3.9	1.8	1.6
Karanj cake	3.9	0.9	1.2
Mahua cake	2.5	0.8	1.2
Safflower cake (undecorticated)	4.9	1.4	1.2
Edible oil-cakes			
Coconut cake	3.0	1.9	1.8
Cotton seed cake (decorticated)	6.4	2.9	2.2
Groundnut cake	7.3	1.5	1.3
Linseed cake	4.9	1.4	1.3
Niger cake	4.7	1.8	1.3
Rape seed cake	5.2	1.8	1.2
Safflower cake (decorticated)	7.9	2.2	1.9
Sesamum cake	6.2	2.0	1.2

Now, let us see the average nutrient content of oil cakes. So, if you can see that among the non-edible oil cake Castor cake contain 4.3 percent nitrogen 1.8 percent of P2O5 and 1.3 percent K2O in case of edible oil cakes you can see coconut cake can contain 3 percent, nitrogen 1.9 percent P2O5 and 1.8 percent K2O if we consider the ground nut cake that contains 7.3 percent of nitrogen 1.5 percent of P2O5 and 1.3 percent of K2O. So, this is how we can see that in different non-edible as well as edible oil cakes, how these nutrient concentrations are continuously varying.

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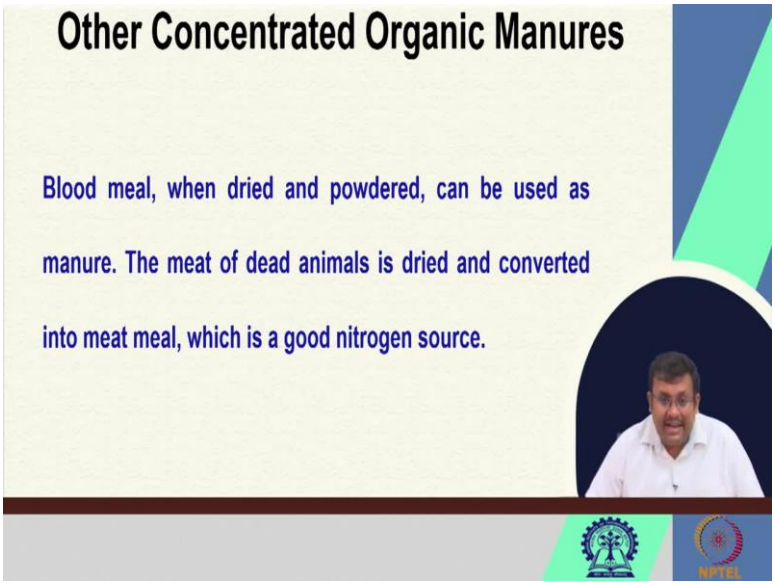

Now, apart from these oil cakes, we can also use animal based concentrated organic manure for example blood meal when dried and powdered can be used as manures. The meat of dead animals is dried also and converted into meat meal, which is a good nitrogen source. These are some of the examples of animal based concentrated organic manures. So, you can see horn and hoof meal and also you can see raw bone meal and crushed bone meal. So, these are different animal based concentrated organic manures.

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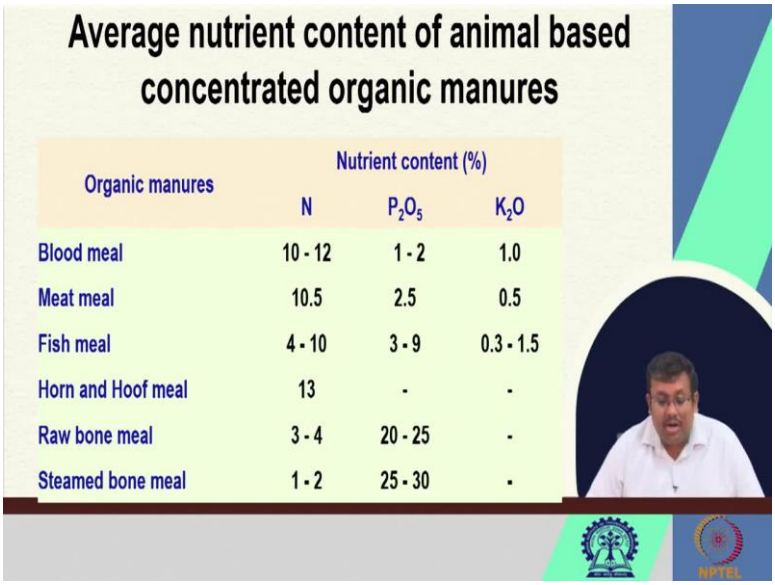

Now, if we consider the average nutrient content of animal based concentrated organic manure we can see that in the blood meal it contained 10 to 12 percent Nitrogen meat meal content highest 10 also 10.5 percent and so this is the nitrogen and P2O5 and K2O distribution among blood meal, meat meal, fish meal, horn and hoof meal, raw bone meal and steamed bone meal. So, this table basically shows the average nutrient content of animal based concentrated organic manure.

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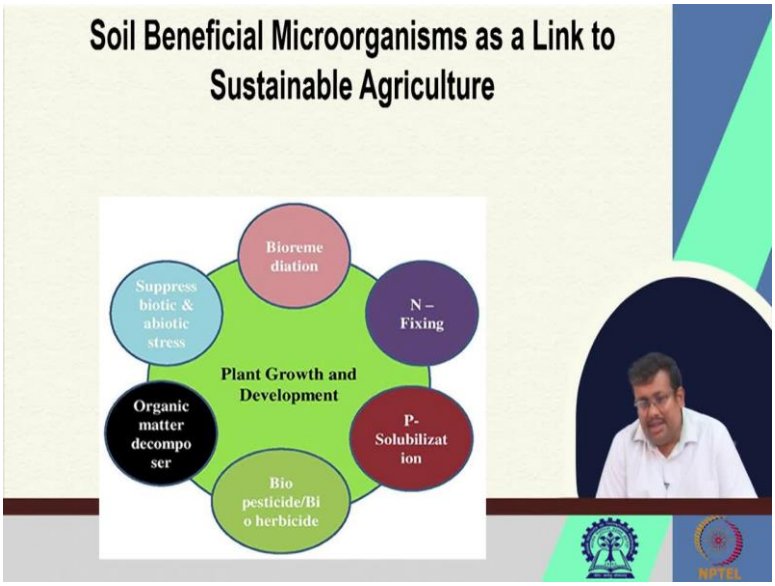

Okay guys we have discussed the bulky organic manure as well as concentrated organic manures. We have seen the farm yard manure we have seen the farm yard manure

manufacturing process we have seen composting, composting process and now we have also seen the green manure and concentrated organic manure.

Now, if we consider the plant growth and development these soil beneficial microorganisms play a very important role for plant growth and development it can either fix nitrogen from the atmosphere through the process of biological nitrogen fixation, it can help in phosphorus solubilization it can also help in bio pesticide formation or bio herbicide formation, it can help in organic matter decomposing it can help inorganic matter decomposition and it can also suppress biotic and abiotic stress.

So, you can see that and also bio remediation, which is another very important process. So, you can see not only the nitrogen fixation and phosphorus solubilization it can also acts as bio pesticide bio herbicide for sustainable pest management and organic matter decomposers so, it can also help these micro microbes can also help for organic matter decomposition specifically in case of compost, and also it can suppress biotic and abiotic stresses and ultimately it can also help in bio remediation.

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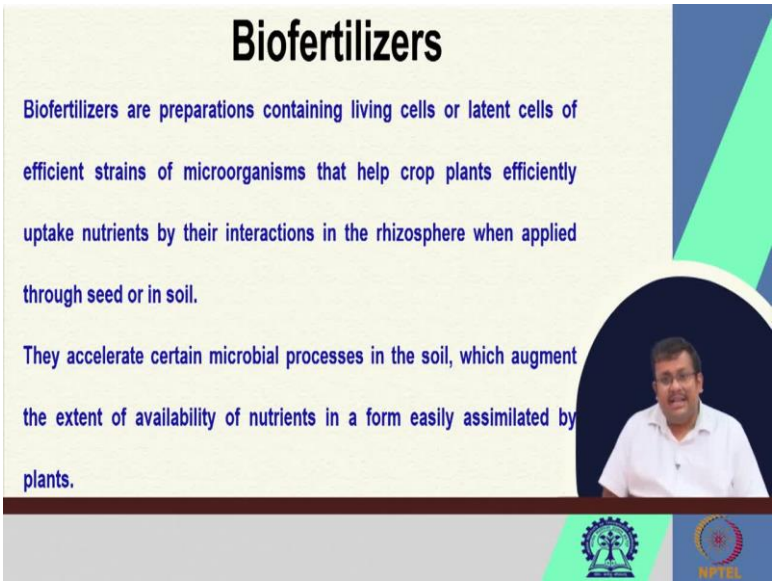

So, that is why bio fertilizers have played a major role in contemporary agriculture. Now, we are going to discuss this bio fertilizer very briefly because, in week 9 we are going to discuss the bio fertilizer and their preparation. In details however, we will just have a very brief overview of biofertilizers remember that biofertilizers are preparations containing living cells or latent cells of efficient strains of microorganism that help crop plants efficiently uptake nutrients by their interaction in the rhizosphere when applied through seed or are in soil.

So, remember one of the major criteria of bio fertilizer is these are living cells or latent cells of efficient strains of microorganisms and we generally apply them through seed or we generally apply them in soil. So, that can they can improve the uptake of the nutrients by their interaction in the rhizosphere. They accelerate the certain microbial processes in the soil, which augment the extent of availability of the nutrients in a form easily assimilated by the plants.

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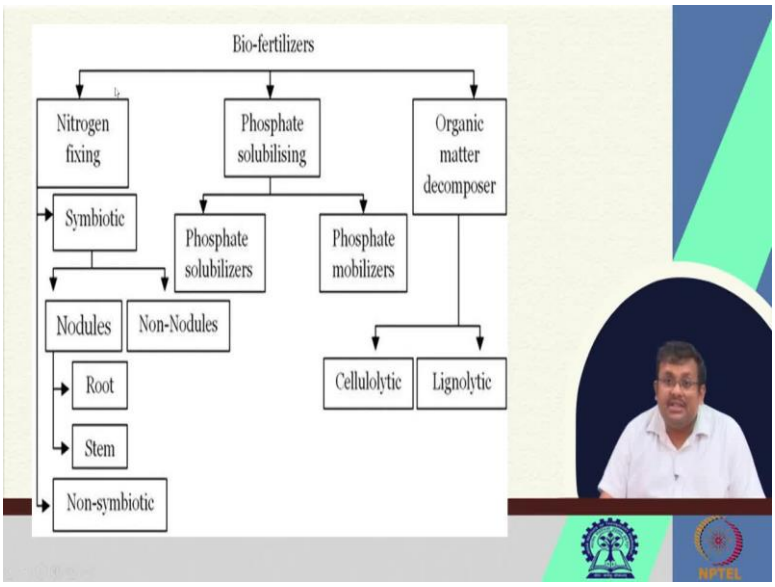

So, if you see the broad classification of bio fertilizer, we can see there are nitrogen fixing bio fertilizer, phosphate solubilizing bio fertilizer and organic matter decomposers among the nitrogen fixing bio fertilizer we can see again they are divided into symbiotic nitrogen fixation and non-symbiotic nitrogen fixation.

So, these are so, synthetic nitrogen fixation can be seen in nodules and non-nodules and nodules can be seen either in root or stem. So, these are the differences there are different nitrogen fixing by fertilizer, when we discuss phosphate solubilizing bio fertilizer, they are of 2 types one is phosphate mobilisers and another is phosphate solubilizes. So, one help in phosphate mobilizing and other helps in phosphorus solubilizing. The third category is organic matter decomposers.

So, these decomposers help in decomposing the organic matter, fast decomposition of organic matter and they are of either cellulolytic, cellulolytic by biofertilizers or organic matter decomposition or lignolytic organic matter decomposers. So, cellulolytic decomposers

basically attacks… cellulolytic microorganisms attack cellulose of the plant cell and lignolytic organic matter decomposers attack the lignin of the plant cell.

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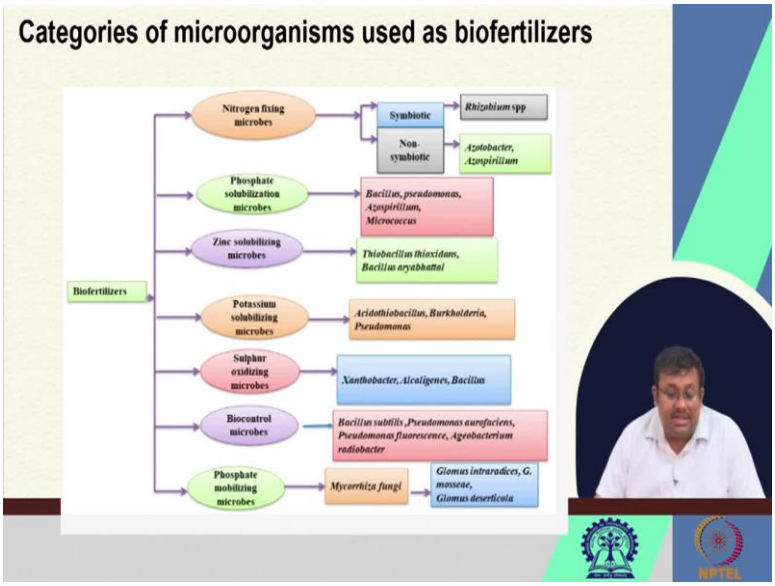

Now, if we first see the further categories of microorganisms, which are generally use as fertilizer you can see nitrogen fixing microbes are either symbiotic example is rhizobium. Non-symbiotic example Azotobacter, Azospirillum. Phosphate solubilizing microorganisms like bacillus, pseudomonas. Zinc solubilizing, zinc microorganisms Thiobacillus, thioxidans and potassium solubilizing microorganisms are you can see Burkholderia Pseudomonas.

Sulfur oxidizing microbes are alcaligenes, Bacillus xanthobacter. Bio control microbes are bacillus subtilis, Pseudomonas and then ageobacterium. So, these are some of the bio control for microbes and finally, phosphate solubilizing microbes you can see mycorrhizal fungi and examples of Glomus, so, these are some of the biofertilizers these are some of the microorganisms which generally use as biofertilizers.

So, guys I hope that the this lecture was useful to generate some important information and we have discussed about the advantages and disadvantages of composting and also we have discussed about green maneuvering, concentrate organic manure their classification, different types of concentrate organic manure and also we have discussed about the nutrient content of different concentrate organic manures. And finally, we have a very brief overview of biofertilizers and we have seen some of the organisms which are which can be used as bio fertilizers.

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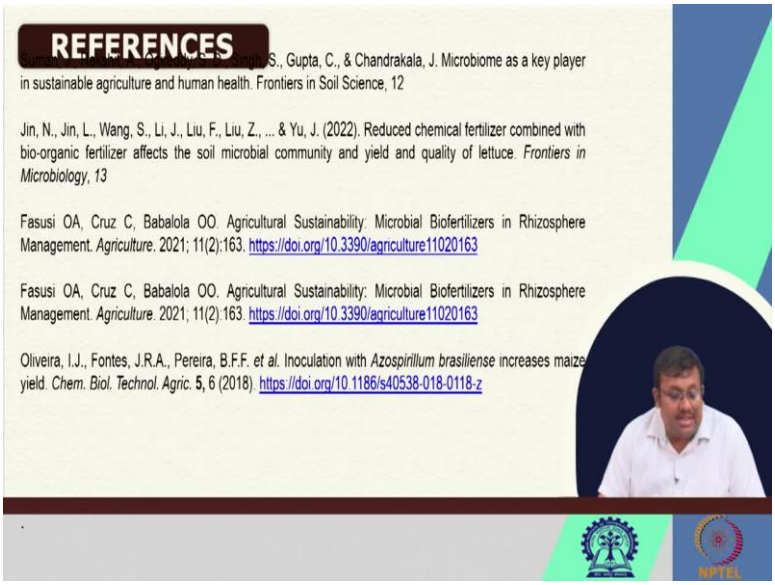

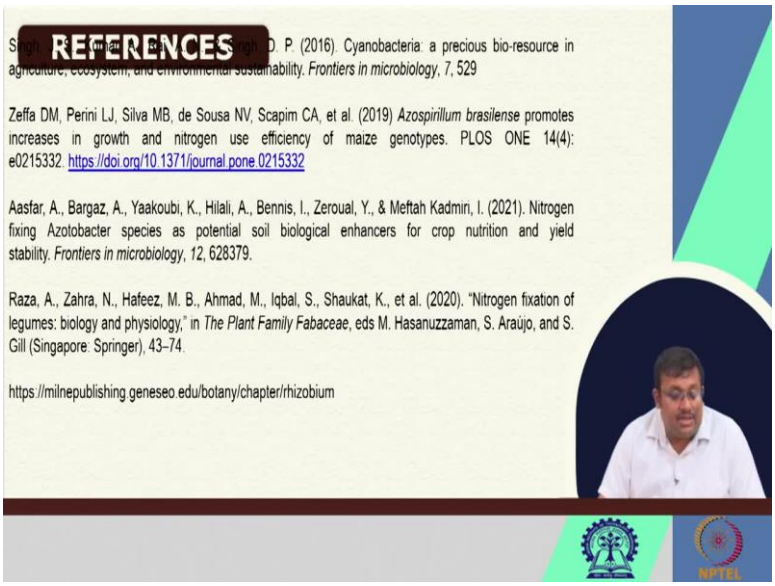

So, these are some of the references guys. So, let us wrap up our lecture today. And we will start from here in our next lecture that is lecture number 38. Till then, goodbye. Thank you very much.