Soil Fertility and Fertilizers
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Lecture: 28
Soil Testing and Soil Fertility Evaluation Methods (Contd.)

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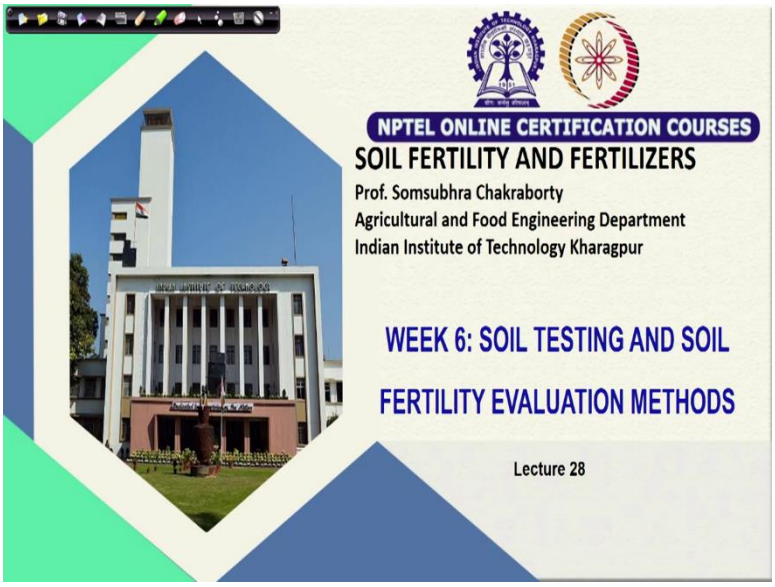

Welcome friends to this third lecture of week 6 of NPTEL online certification course of Soil Fertility and Fertilizers. In this week six 6 we are discussing about soil testing and soil fertility evaluation methods. In our previous 2 lectures, lectures number 26 and 27 we have already discussed the basis of soil fertility evaluation and what are the different methods for soil fertility and plant nutrition status estimate identification.

So, we have also discussed what are the plant based methods and how you can diagnose the plant nutritional status by measuring different types of plant parameters we have discussed, we have also discussed the DRIS concept. Now, in our previous lecture we have discussed about basics of soil testing and how we should collect the samples, what are the different types of soil sampling procedure, we have discussed simple random sampling then stratified sampling then grid sampling and different types of grid sampling.

Apart from that, we have also discussed the zone sampling and hybrid sampling and we have discussed their advantages and disadvantages. So, in this lecture, lecture number 28, we are going to discuss how we should collect the soil samples from the field, how we should process it and then how to preserve those soil samples for subsequent analysis.

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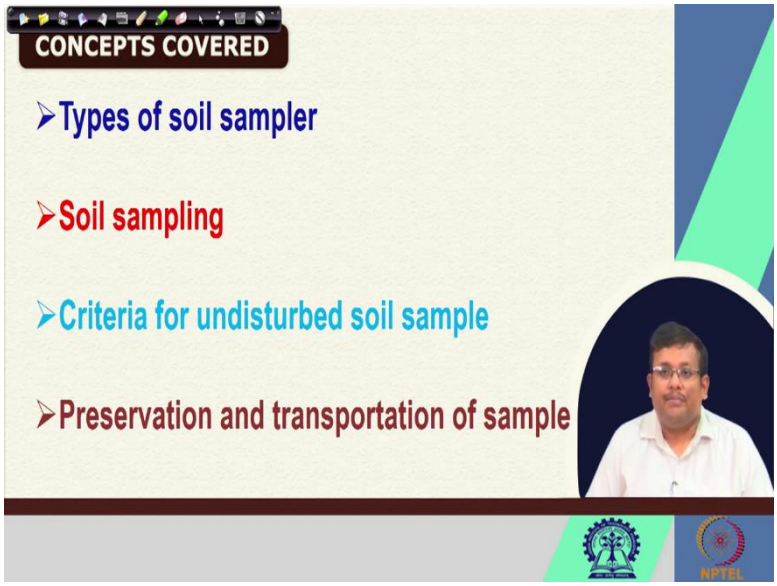

So, in this lecture, these are the concepts which we are going to cover first of all different types of soil sampler and then soil sampling procedure and then criteria for undisturbed soil sample and also how to preserve and transport the sample.

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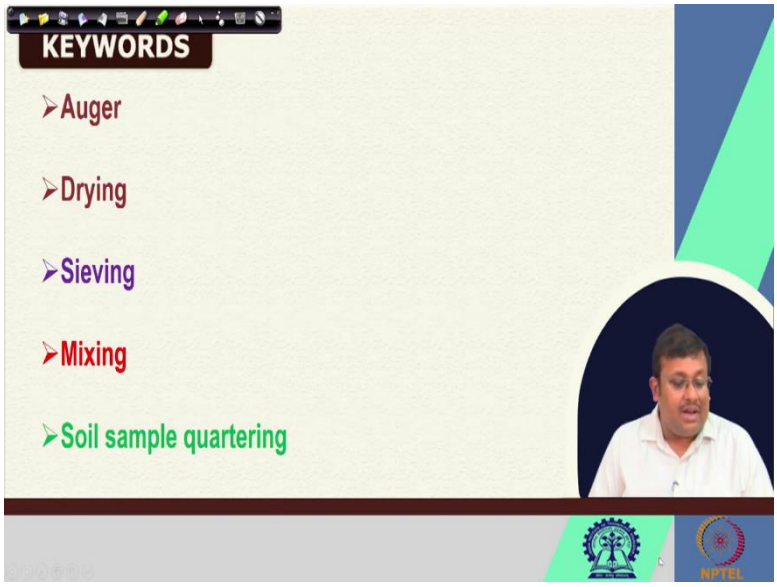

So, these are also different types of keywords auger, drying, sieving, mixing, soil sample quartering, so, these are the keywords which we are going to discuss in this lecture.

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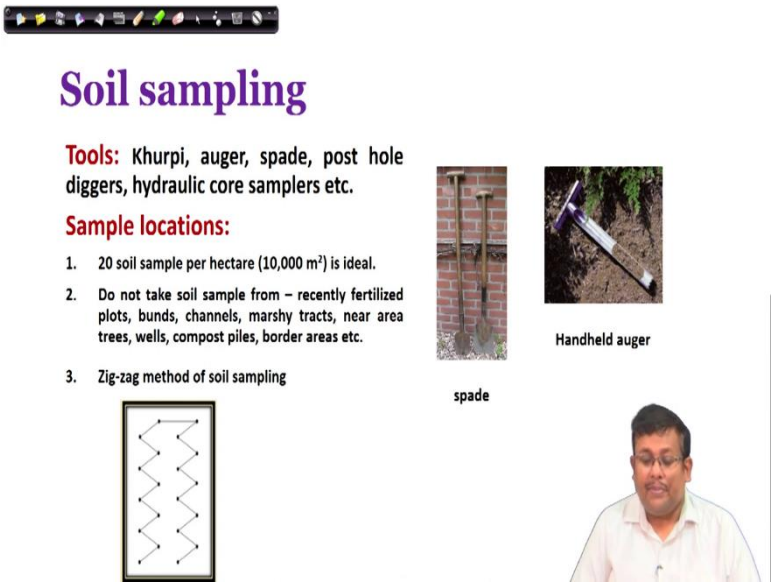

So, we already know that in the field, you can collect the soil samples based on different criteria suppose, you can go with the simple random sampling or sometime you can go for stratified random sampling. And also you can go with the zone sampling. Now, there are several soil testing, soil sampling tools like khurpi and or hand shovel and auger then spade, post hole diggers, hydraulic core samplers etcetera. Remember for a normal soil testing process, we generally recommend that you should collect at least 20 samples per hectare that means, you should collect around 20 samples per 10,000 square meter of area.

And as I have mentioned in my previous lecture, we should not take any soil samples from recently fertilize plots, bonds channels, marshy tracks near area trees, wells, compost piles and border areas, etc. And as I have mentioned in my previous lecture also that we generally recommend that you should collect the sample in a zigzag fashion as you can see in the lower most picture.

So, here we can see we are taking the soil samples in zigzag fashion from an area and how why we do this, we do this because in this fashion you can capture the maximum variability or special variability in the samples. So, this is the method which we generally recommend to our farmers for collecting the soil samples and there are different types of tools as you can see spade, handheld auger, auger is a specialized soil sampling tool and there are different types of auger for different types of soil condition.

You can you know for very hard soil, you have screw type auger and also there are different other types of auger also, for different soil conditions these augers are really helpful to collect like the size samples from a desired depth.

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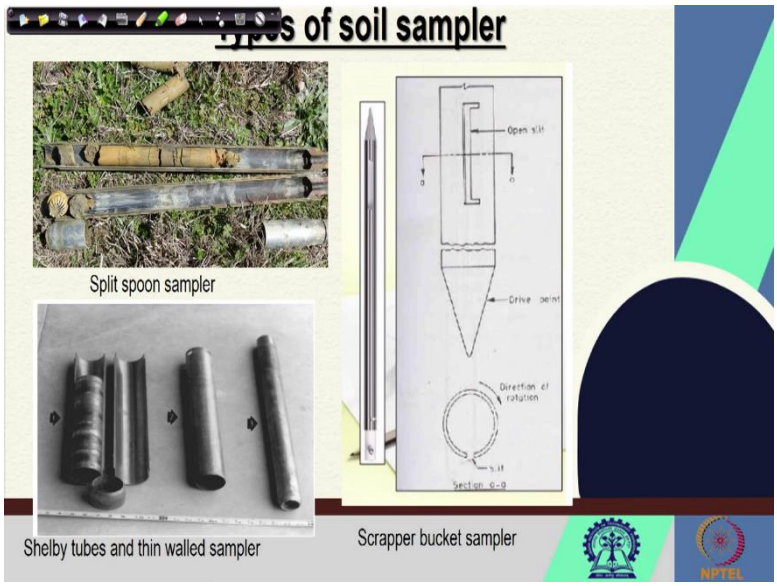

So, apart from that, there are core samplers also, you can see here different types of core sampler like split spoon sampler and also you can see Shelby tubes and thin wall samplers and scrapper bucket sampler. So, there are different types of soil sampling tools, which we generally use for collecting the soil samples and characterizing the soil samples at different depths.

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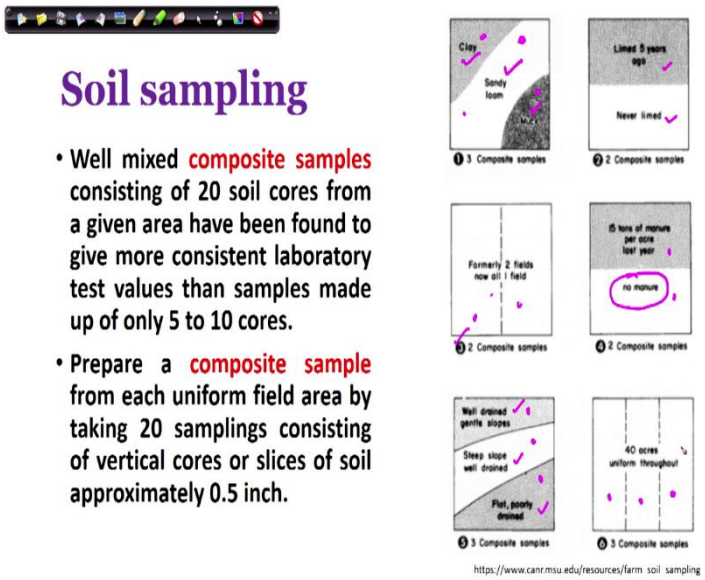

So, we also should remember that, you know soil sampling generally sometime we recommend that we should create a composite sample consisting of 20 soil cores, as I had mentioned in the previous slide that we generally recommend to collect 20 samples per hectare area, then after collecting those 20 samples, you can mix them together to make a composite soil samples.

And so, when you develop this composite sample by mixing these 20 different soil cores from a area that is generally found to be more consistent, you know, then, you know, if you use only 5 to 10 cores, so, that is why we generally recommend that you should collect at least 20 samples to give a proper representation of the soil properties of your field.

Now, you should prepare a composite sample from each uniform field area by taking 20 sampling consisting of vertical cores or slices of soil approximately 0.5-inch thickness. So, we will discuss this in our next slide, but at this point of time, you just remember that here you can see the soils are you know, the area is divided into mucky muck soil sample that sandy soil samples and clay soil samples.

So, we should collect 3 composite soil samples from each of these area and each of these composite samples should be made from at least 20 soil samples collected from each of these different zones. So, this is one method another way if you see that, there are 2 zones of an area that in which one of them is lined 5 years ago and that is never lined. So, you can collect 2 composite samples from these two areas.

Sometime you know, in this in this case, where formerly there are 2 fields, but now they have been merged together. So, you can also collect 2 composite samples from these 2 different fields which have been merged together. So, also you can see here there are two zones where one of them got no manure and another one has received the 15 tons of manure per year per acre last year.

So, you should collect 2 composite sample from this area. Also, you can collect 3 composite samples from this area depending on the topography. So you can see this is well drained, gentle slope, then steep slope well drained and flat pollutant, so, you can collect 3 composite samples from these 3 areas. Apart from that you can also collect 3 composite sample from a big area and you can divide into three different part and then you can take a 3 composite sample from this 3 area. So, this is how you should collect and you know you should collect

the composite samples because composite samples are more representative than you know than individual samples.

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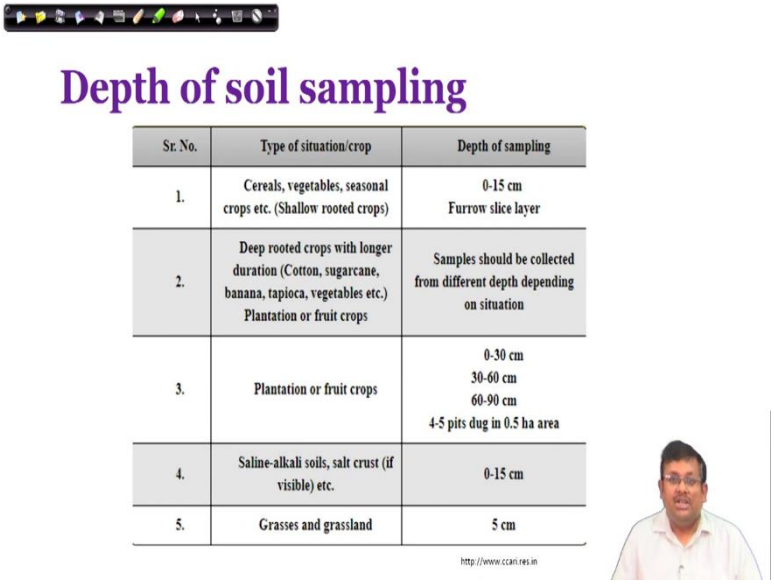

Now the most important thing comes to our mind, what should be the proper depth of soil sampling? Well, you can see here depending on the type of the crops the depth of the soil sample generally varies. So in case of cereals, vegetables and seasonal crops, or shallow root crops, generally we go with 0 to 15 centimeter because they are rooting generally root depth goes up to 0 to 15 centimeter.

So, that is why we should collect the soil samples from 0 to 15 centimeter because the roots are the one who are which you know, the root system basically collects the nutrients from the soil so we go up to 0 to 15 centimeter, we call it a faro slice layer also. And for deep rooted crops with longer duration like cotton, sugarcane, banana, tapioca, vegetables, etcetera, are also plantation or fruit crops we generally you know, collect the soil samples from different depths depending on situation. For plantation and fruit crops we can collect the soil samples from 0 to 30 centimeter, 30 to 60 centimeter, 60 to 90 centimeter and we generally, you know, dig 4 to 5 feet in half hectare of area and then we collect the soil samples from those different depths.

For saline alkalis soils or salt crust soils, we generally go with the sampling from 0 to 15 centimeter and for grasses and grasslands, which are very short root, we generally collect soil samples from 0 to 5 centimeter depth.

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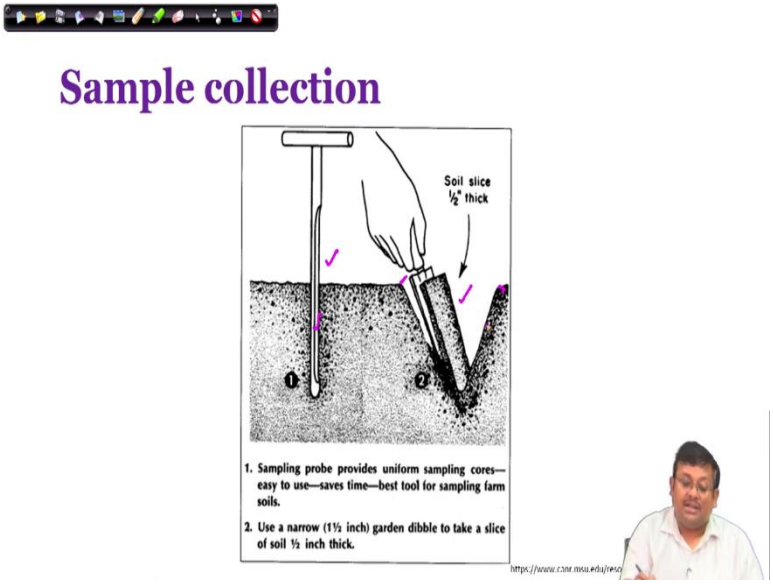

Now, generally as I mentioned, there are different types of tools which you generally used for collecting the soil samples. Now, here you can see in this picture, there are two tools, one is the auger which you can generally press in the soil and then we can collect a soil materials in this auger, another one we can use these V shaped cut. So, in this V shaped cut we generally use either hand shovel or spade.

So, here you can see generally you we make a V shaped cut and then you know remove the soil from inside and then using the hand shovel, we got a half-inch thick slice from the both the sides and then mix them and then collect it until we get a total of around half of kg of sample. So, this is how this is called the furrow slice layer and this furrow slice basically 0 to 15 centimeter goes up to 0 to 15 centimeter because most of the crop roots grow up to 0 to 15 centimeter for cereals and field crops.

So, we collect the half-inch thick slice from both the sides and mix them together to get the composite sample. So, this is the most advisable method for the farmers. So, they generally collect the samples using this method.

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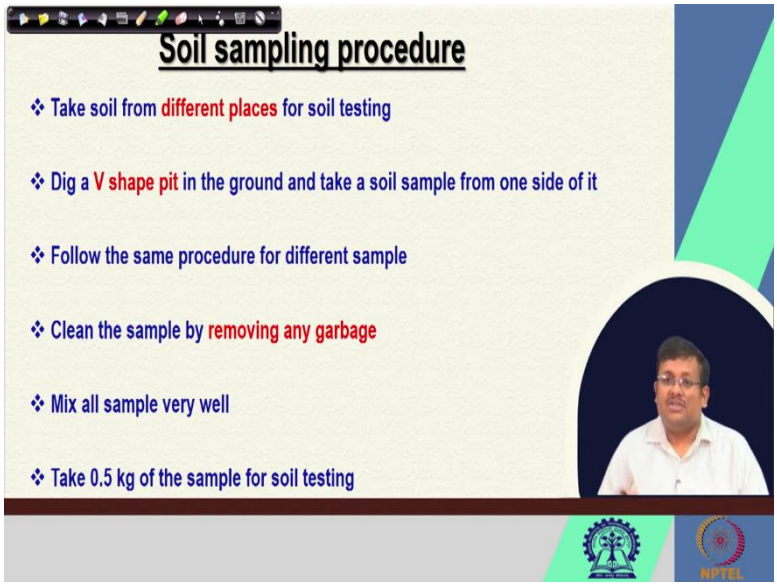

Now, what are the process, what is the procedure of soil sample collection? First of all you should take soil samples from different places for soil testing, and you have to dig a V shaped pit in the ground and take a soil samples from one side of it and then follow the same procedure for all the different samples. And then after you collect the samples, you have to clean the samples by sieving because once you collect the sample there may be some debris, there may be gravels, there may be some twigs and other things.

So you have to remove them and then you have to mix them together to make a composite sample. Once you make a composite sample, then you take only 0.5 kg of the sample for subsequent soil testing because for most of the soil testing parameters, you can do most of the soil testing parameters using only 0.5 kg of the total soil sample. So, this is all simple procedure.

Remember that when you go to the field and collect the soil samples, before making a V shaped cut, you should scrap off all the twigs and other plant materials and other debris from the surface of the soil, then you make a V shaped pit and then collect the slice from the furrow slice layer. So, this is how you collect the soil samples.

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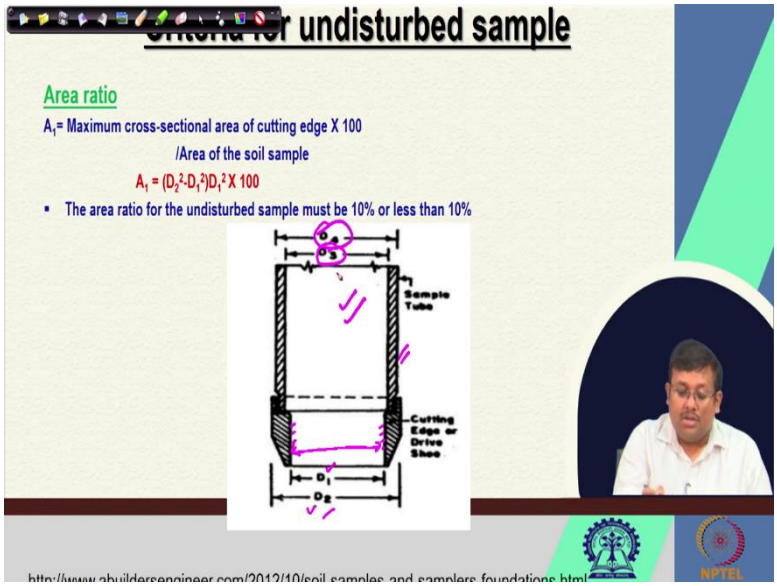

Now, what is the criteria for undisturbed sample sometime we require undisturbed samples for certain soil property estimation. Now for undisturbed soil samples, we have to think about an area ratio concept. So, in this you know, in this core sampler, you can see if this distance is called the D1 and the D2 is the distance I mean here you can see this is the cutting edge or driving drive shear.

So, the distance between this is called D1 and the distance of the sampling tube, I mean the wall between the sampling tube is D2. So, here also this is basically the sampling tube and this is the cutting edge and the distance between the inner wall of the cutting edge is D1 and the outer wall is D2. So, also if we consider the sampling tube, the distance between the inner wall is D3 and the distance between the outer wall is D4.

So, based on these measurement, we generally calculate several you know several index or indices, first of one is aspect ratio. So, area ratio is generally denoted by A1 which is basically maximum cross section area of a cutting edge multiplied by 100 by area of the soil sample so, it simplifies to D2 square minus D1 square multiplied by D1 square into 100.

So, the area ratio for undisturbed sample must be 10 percent or less than that. So, for undisturbed soil samples, we generally measure different types of soil properties basically soil physical properties. So, these areas ratio for undisturbed soil samples should be less than equal to 10 percent.

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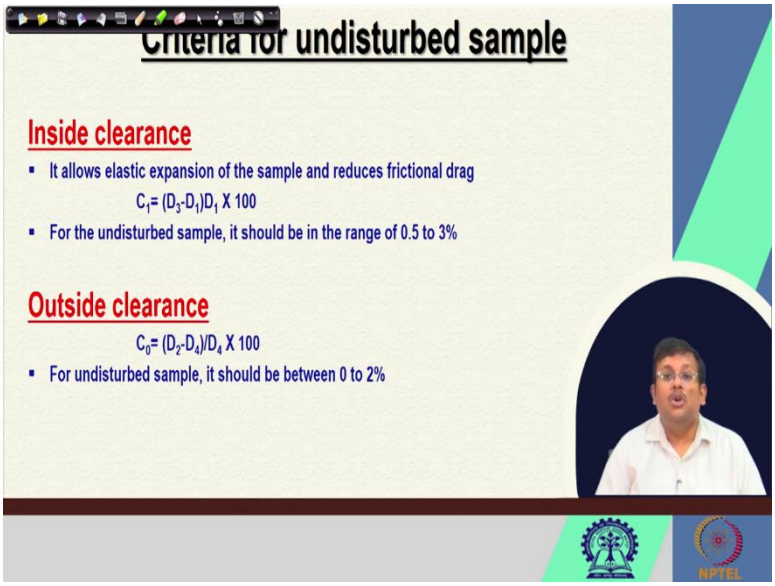

Now, inside clearance is another important criteria. So, it allows the elastic expansion of the samples and reduces the frictional drag. So, it is collect, it is calculated by you know you by multiplying the difference between D3 and D1 with the D1 and 100. So, we generally denote these inside clearance as C1 remember that for the undisturbed sample it should be in the range between 0.5 to 3 percent. And also as far as the outside clearance is concerned which is denoted by C0, it is basically D2 minus D4 by D4 into 100. So, for undisturbed sample it should be between 0 to 2 percent.

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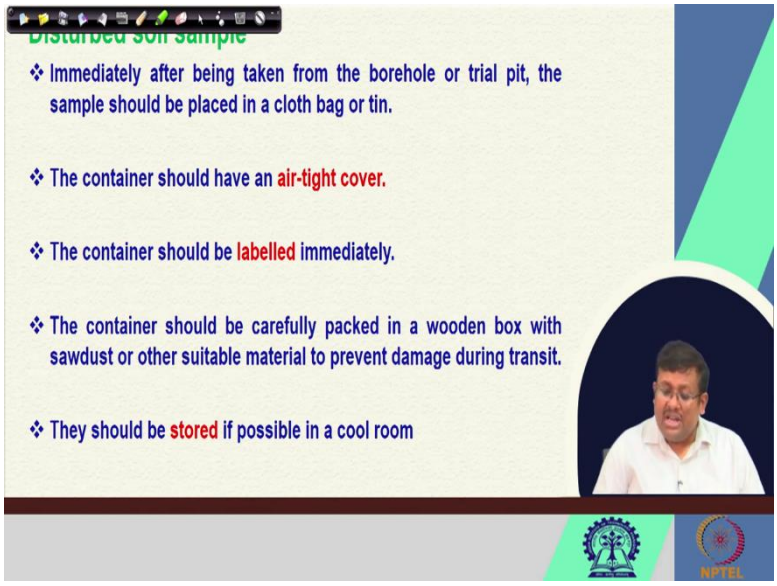

Now, in case of disturbed soil samples, in case of disturbed soil samples we should immediately you know when you take the soil samples from the pit, the sample should be placed in a cloth bag or tin, generally we prepare generally we collect the samples in either a cloth bag or we collect the samples in a Ziploc bags also and remember then, then we should the container should have an airtight cover so, that there is no moisture loss.

Now, once you collect the soil sample, it is very important to properly label the container or the packet. So, you know what are the labels for example, you should label the name of the farmer, proper location of the sample by using the GPS coordinates, you should also write down the depth from which you have collected the time of the sampling whether there is a standing crop, whether there is a fallow, what type of crop to be grown and also what was the previous crop all this information should be contained in this you know should be contained in the sampling bag or sample container.

So, the container or bag should be carefully packed and the container should be packed in a wooden box with sawdust or other suitable material to prevent damage during the transit and they should be stored if possible in a cool room. So, this is the general procedure for sample collection and sample transportation.

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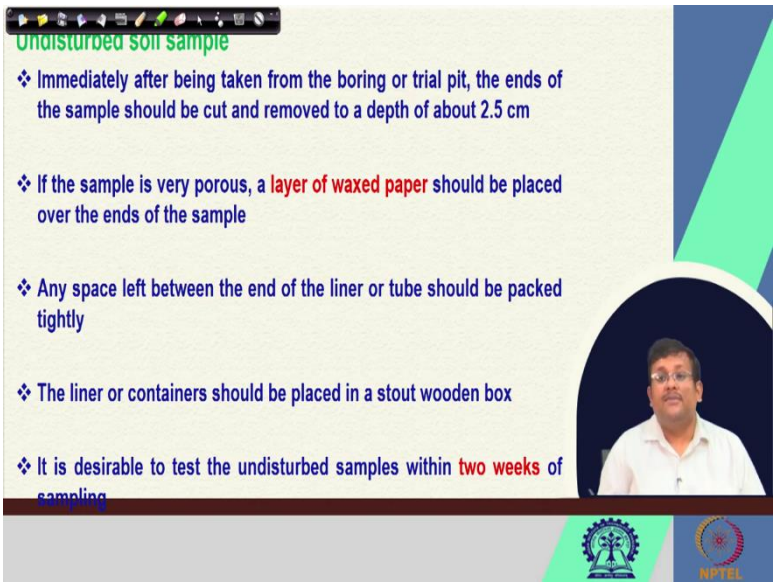

Now, in case of undisturbed soil sample immediately after being taken from the boaring or trial pit, the ends of the sample should be cut and removed to a depth of about 2.5 centimeter now, if the sample is very porous, a layer of wax paper should be placed over the ends of the sample and any space left between the end of the liner a tube should be packed tightly the

liner or container should be placed in a stout wooden box and it is desirable to taste the undisturbed samples within 2 weeks of the sampling.

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Now, these are different process of sampling as you can see, that people do using these augers you know you can you know directly push this auger into the soil and then you can collect the soil samples from a desired depth and also you can use this hand shovel to collect the soil samples from the furrow slice layer or you can collect the soil samples in using a core sampler.

So, core are basically cylindrical sampling attachment which we generally use to collect the soil undisturbed soil sample for different types of measurement. So, specifically the density measurement we use using the core sampler. So, these are different photographs of soil sampling.

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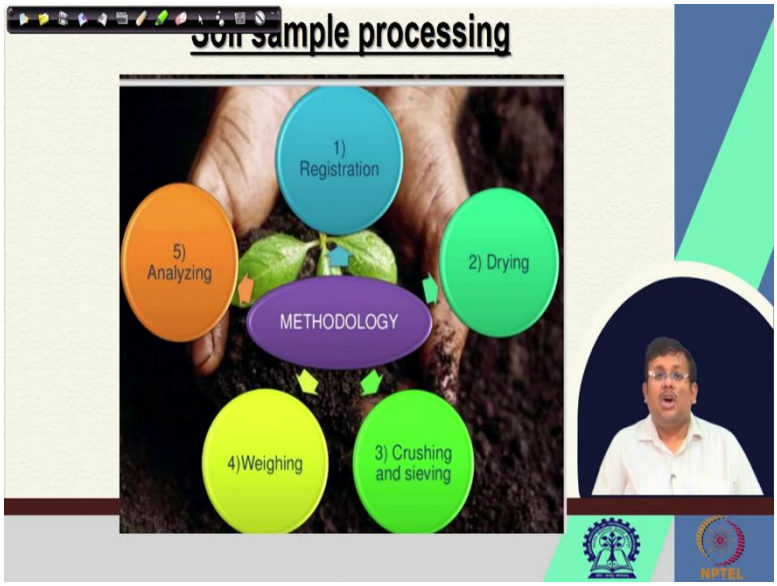

Now, soil after you collect the soil sample there are several methods of soil processing. First of all the registration that means once you collect the soil samples, you must properly register the sample with the all the related information which I have just mentioned. That means collection time, collection location, then what was the crop what is next crop to be grown and whether the soil was fertilized or not and also, if there is specific condition from that sampling location, whether there is a water stagnant near the sample near these zone and also other important, other important information should be registered.

Then second step is Drying. So, remember that when you collect the soil sample there field moist most of the time, so, you should dry the soil samples and then after you bring into the lab, before you go for different types of soil, traditional soil chemical testing, you should dry the soils. Now, drying the soils is generally recommend under a shaded area, so, that there should not be any loss of organic matter because if we dry the soil samples in a in a high temperature there is a chance of removal of organic matter from the soil due to oxidation.

And we do not want that, because organic matter is an important property of the soil and we want to measure that in the laboratory. So, to minimize the removal of soil organic matter due to drying by drying at high temperature we generally place the samples in some brown papers and then keep it within a shaded, under a shaded area. And then generally we avoid direct sunlight to prevent any type of reaction and then we keep it for couple of days so that the soil can become you know relatively dried.

After the drying then we crush the soil samples and then we sieve the soil samples because you know that by definition of the soil, the size of the soil should be less than 2 millimeters. So, most of the cases for soil chemical analysis you will see that will crush the soil samples and then we sieve the soil materials which with the less than 2 millimeters of you know size of the particle then we weigh the soil sample and then finally, we analyze the soil sample for several properties. So, these are the five major steps of soil sample processing.

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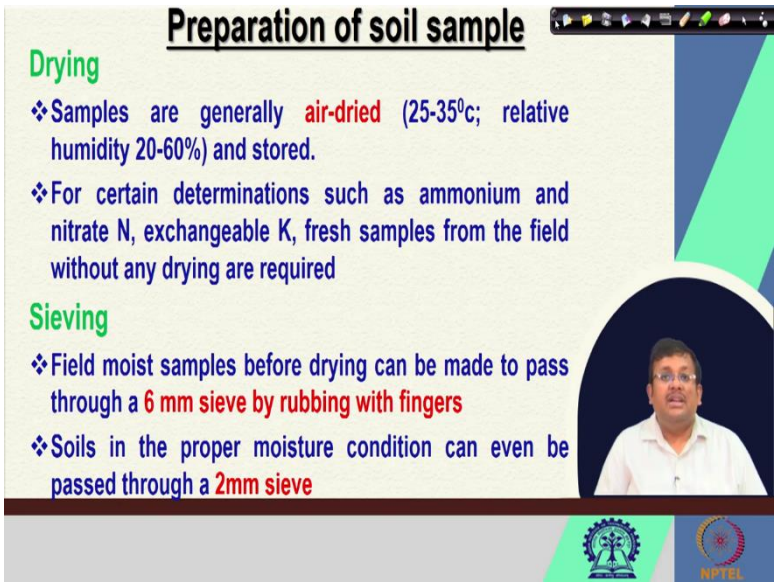

Now, preparation of the soil sample let me, so the preparation of the soil sample, you can see that first of all is drying. So samples are generally air dried as I have told you in 25 to 35 degrees centigrade, where the relative humidity is around 20 to 60 degree, 20 to 60 percent and after the drying we can store it. So for certain determinations such as ammonium and nitrate nitrogen exchangeable potassium fresh samples from the field without any drying are required.

Second step is sieving step. So field moist samples before drying can be made to pass through a 6 millimeter sieve by rubbing with the fingers. And soils in the proper moisture condition that means dried soil can even be passed through a 2 millimeters sieve. So once we collect the soil sample, if they are relatively dry, we can directly sieve them with the 2 millimeters sieve, I otherwise we can dry them and then we crush them and then we can sieve them to pass this 2 millimeter sieve, and the sample we generally use for measurement of available nutrients, we generally use this less than 2 millimeters particle size sample.

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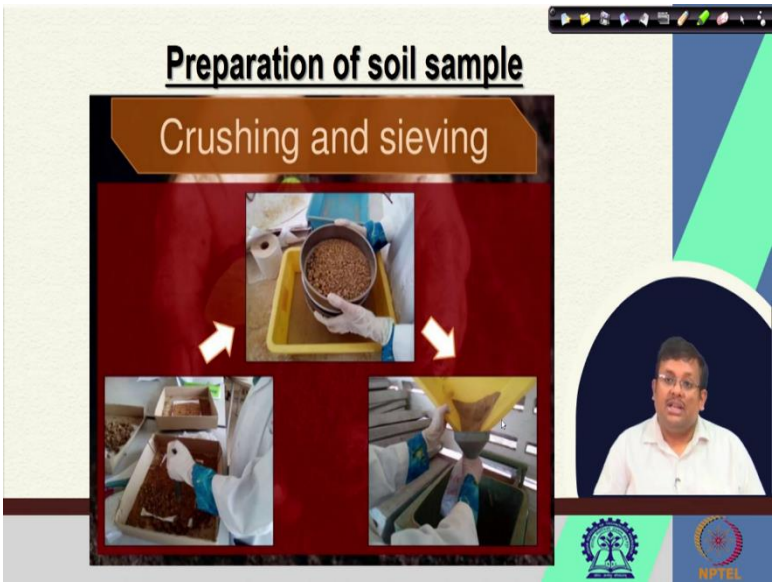

So, you can see here these are the photographs of crashing and sieving. So, we generally use these brass sieves and after that, we you know we first crush this and then sieve it and then we will store it inside the sample box or sample container or plastic or polythene Ziploc bags.

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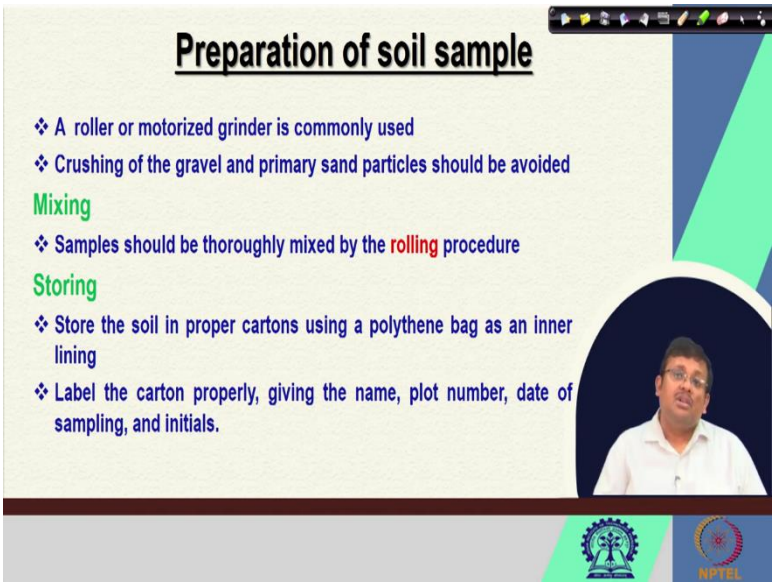

Now, while we crushed the soil sample, generally remember that a roller or motorized grinder is commonly used and also crushing of the gravel and primary sand particles should be avoided. So anything which is beyond 2 millimeters these are called gravels and we should remove those and we should not crush those and also so and also the primary sand particles

should not be crushed, so that they can interfere with the results and samples should be thoroughly mixed by the rolling procedure.

And then what is, what about storing, so we have to store the soil in proper cartons or proper bags using a polythene bag as an inner lining and label the carton properly giving the name, plot number, date of sampling and initials and other important information. So, these are the major steps for preparation of the soil sample.

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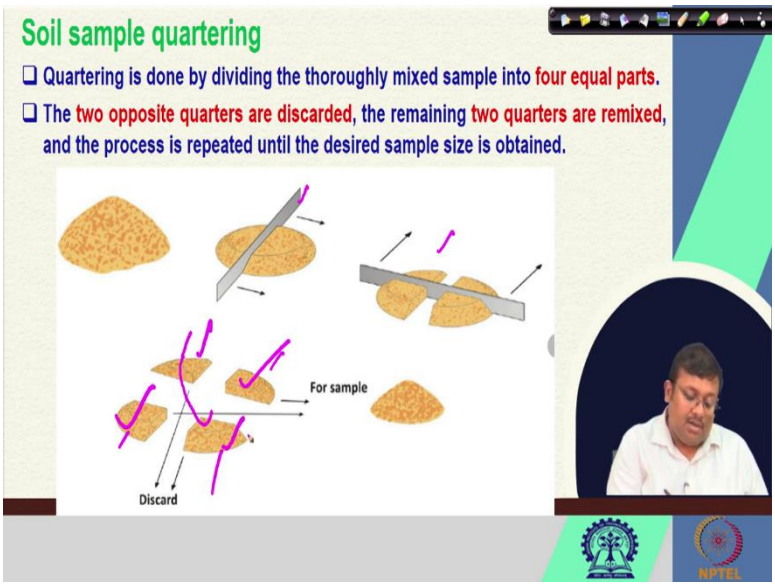

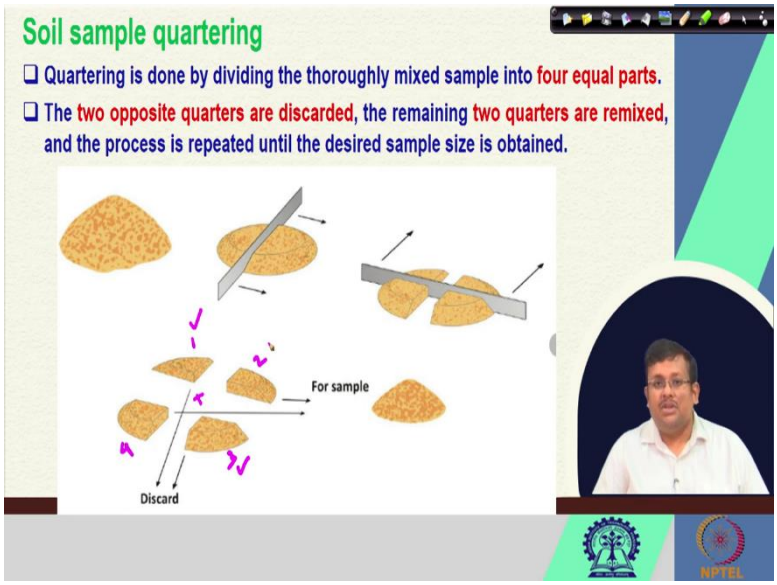

Now, the another important process is called Soil Sample Quartering. What is quartering and why it is needed? So, quartering is generally done by dividing that thoroughly mixed sample into four equal parts, four equal parts and the two. So, here you can see, we are mixing the

samples thoroughly and then we make, we are making the four equal parts. So, we are making the four equal parts and then the two opposite quarters are discarded.

So, we can discard these two opposite quarters. So, we can either discard these two or we can discard these two and in this way this you know and the remaining. So, suppose we are removing these two quarters so, then we will be mixing this one and this one.

So, let me do it in a more so, here you can see 1, 2, 3, 4 So, if we remove 1 and 3, we have to mix in the next step we have to mix samples you know the quarter four and quarter two. So, this will reduce the sample size and we will repeat the process until the desired sample size is obtain. So, generally for soil testing purpose for plant fertility estimation 0.5 kilos or 500 grams of soil sample is enough to you know enough to complete all the nutrient and other essential soil testing process for determining soil fertility. So, this is called the sample quartering process.

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So, these are some of the pictures of real soil sample quartering, as you can see, the crushed samples are the samples after drying, they are basically you know, making the quarter and then removed the two opposite sides and then mixing the two others, you know, the two remaining sides and then they are putting it inside the bag which is sufficient for soil testing.

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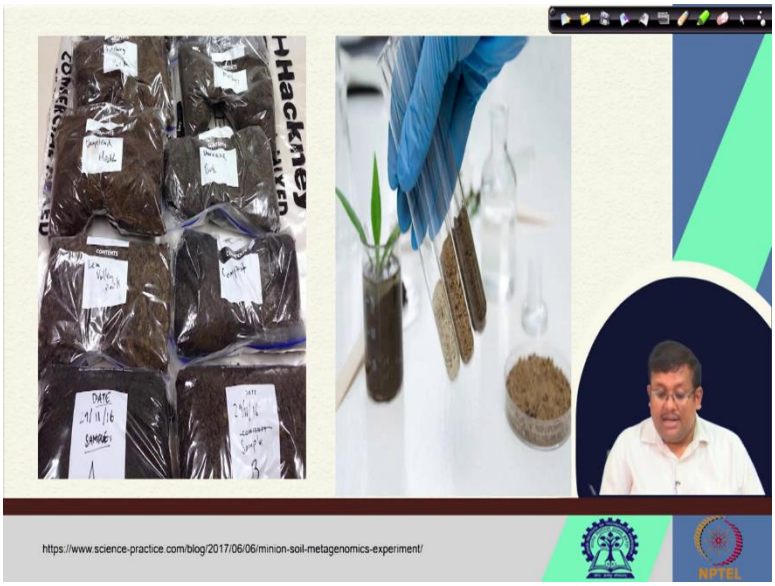

So, this is an ultimately once all the soil sample soils are processed that means, after the collecting the soil samples, we first dry them or first remove the debris and then dry them, then crush them then sieve them and then making the quarters and keeping the required amount of sample and I finally you will see that these should be the you know the sample in the store in the bags.

So, after we collect the soil samples, we preserve it and then we measured their soil properties in the laboratory. Remember the collection and processing of the soil are the two very important steps any you know any error at these two stages may be may impact with the soil results or soil fertility properties. So, we should be very very careful while handling this process. While collecting the soil samples we should always avoid those areas from which we should not collect the soil samples and after that, once we collect the soil sample, we have to ensure that the composite sample is properly representing the whole area.

Otherwise, we have to divide the area based on several factors like whether it was manured or not manured also depending on different types of topography criteria's we should divide the area and then we should collect the composite sample from each of these area because composite sample will be true representative of the variability of that soil property.

After we collect the soil samples or composite soil sample, then we dry then grind or crush and then you know sieve it for subsequent analysis. So I hope that guys, this lecture gives you a good understanding of how we do soil collection and soil sampling or soil sample processing, and storing.

So I hope that these are now clear to you. If you have any questions, please post your question in the forum and I will be more than happy to answer your queries. And so, let us wrap up this lecture these are.

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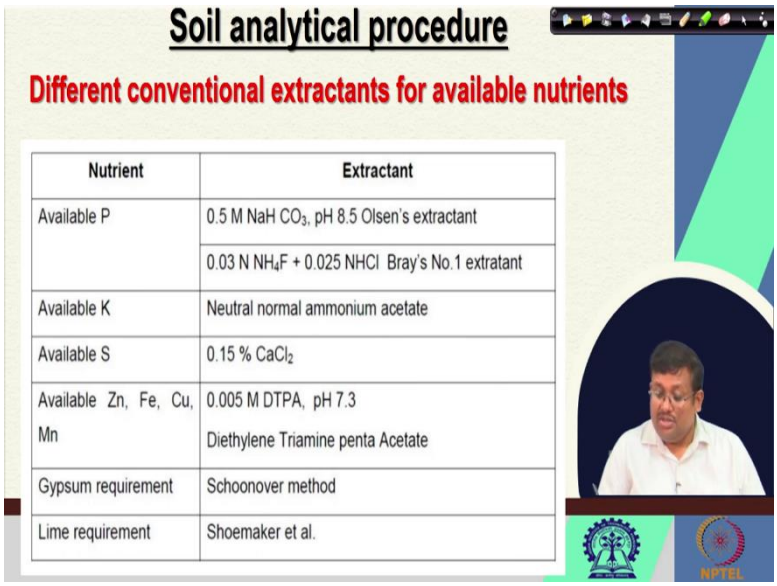

So, one more thing I just forgot to mention that there are different types of conventional extractants for available nutrients. So, once we have that soil sample ready for subsequent analysis, these are different types of methods or extractants which we use for extracting the available nutrients. Like for available phosphorus we use either 0.4 molar sodium bicarbonate which is known as the Olsen's extractant and or 0.03 normal ammonium fluoride plus 0.025 normal of hydrochloric acid that is also known as Bray's number 1 extractant.

For available potassium we use neutral normal ammonia acetate solution, for available sulfur we use 0.15 percent of calcium chloride solution, in case of available zinc, iron, copper, manganese we use extracting agent DTPA which is a chelating agent Diethylene Thiamine Pen Acetate. So 0.005 Molar at pH 7.3. And for identification of the gypsum requirement we use Schoonover method and for lime requirement we use Shoemaker's method.

So we will be discussing how to measure available phosphorus, potassium, sulfur and other micronutrients in our subsequent lectures, in our upcoming lectures. So, these are the major soil analytical procedures.

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So these are the references which I used for this lecture, if you have any query please feel free to ask me the question and I will be more than happy to answer the queries. Thank you.