Soil Science and Technology
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Lecture – 09
Soil Orders, Soil Colour and Texture

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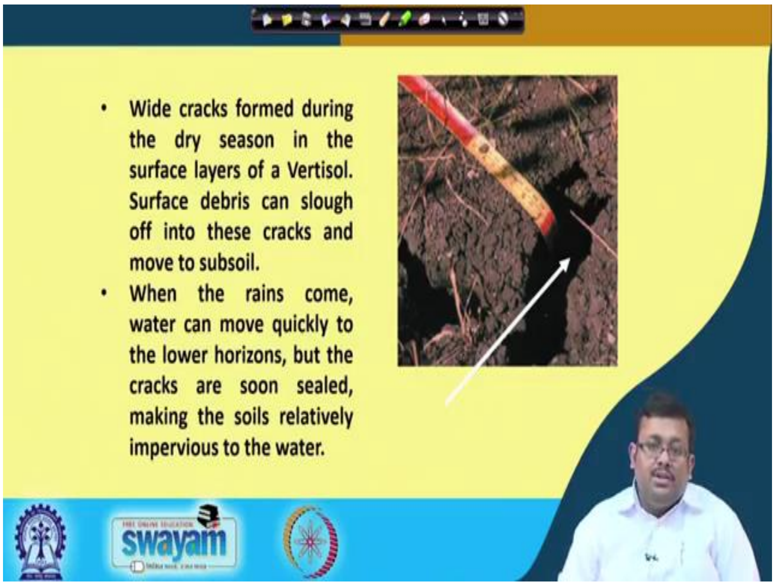

Welcome friends, in this lecture of Soil Science and Technology. And, today we will be finishing, will try to finish the soil classification. So, we will start from the slide where we left in the last lecture. So, in the last lecture, we were talking about different you know vertisols and what are the important characteristics of vertisols.

So, we discussed that vertisols basically forms wide cracks during the dry season and you know they swell during the wet season. So, these properties called swelling and shrinkage property and these are very important property as per as the vertisol properties are concerned. Now, another important feature is called slickenslide and let us see what is slickenslide.

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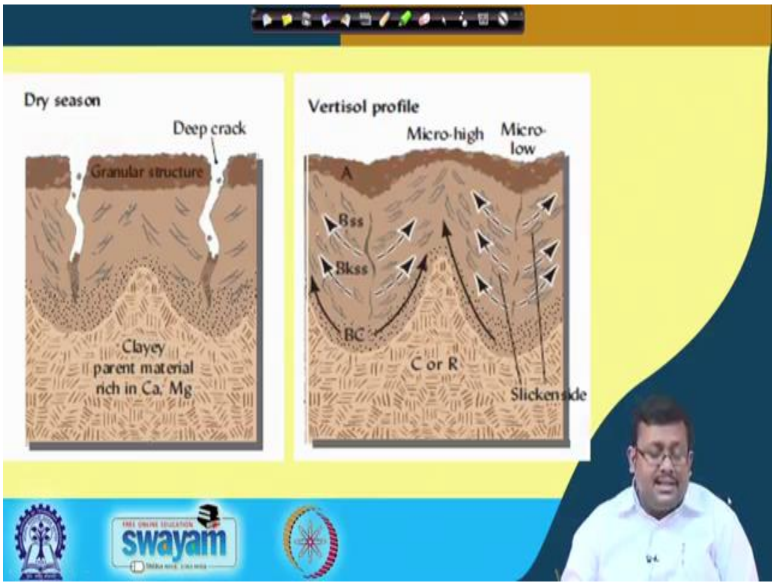

Now, as I have told you during the dry season in the vertisol they develop these larger cracks and in this larger cracks the surface soil particles they generally move due to different types of wind actions or different types of animal actions and then the sill this cracks.

Now, during the during the rainy season or during the wet season when water moves down to this cracks and when they move down to the cracks and fill this cracks these cracks swell and as a result of swelling there will be soil volume increase. So, since the soil volumes increases this excessive soil tries to go in this way and it produces the pressure from both the sides and tries to protrude out.

And, as a result of that there will be some features oblique features these are these are present in oblique angles and we call it slicken slide. And, these excessive due to the ceiling action of water in the vertisol, the excessive volume due to the excess volume of the soil the excess soil material tries to move out in two opposite directions. And as a result of that in the BSS horizons there will be some shiny characteristics and this shiny features which are present in oblique angles are called slicken slides and as a result of this type of clay movement and the ceiling action there will be some ephemeral lakes which are form at the surface we call it gilgai relief.

So, swelling and shrinkage property, slicken slide this gilgai micro relief are important features of vertisols and you will see this features when you visit this particular type of soils specifically the black cotton soil of Maharashtra.

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Obviously, you can see the slickenslide features these are shiny features present in vertisols.

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Now, let us see what is oxisols. Oxisols are deeply weathered soils of humid tropics with you know with brick red color and basically they are dominated by kaolinite and sesquioxide you know the sesquioxide basically is the combination of iron and aluminium oxides and basically we do not see this type of soils very much in India.

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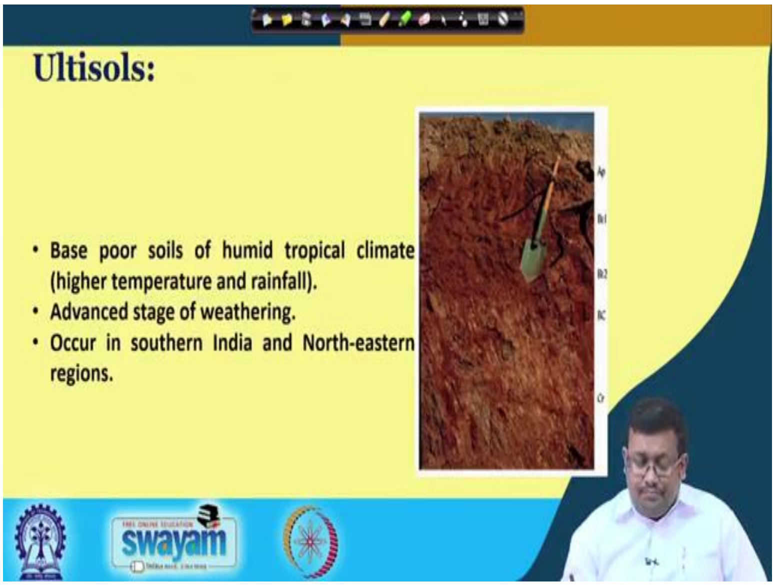

The another important soil is called ultisols. So, now, it is basically highly weathered soil which are base poor and they generally occur in humid tropical climate where higher temperature rainfall is there and obviously, as I have told you it shows basically advanced stages of weathering and it occurs in southern India and north eastern regions of India.

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Alfisols: alfisols is the another important soil order which is widely distributed in India and alfisols contains argillic horizon which you know you can see there is a clear evidence of illuviation and eluviation. And, as you can see in this in this soil there is a clear eluvial horizon and clear illuvial horizon where illuviation of clay; that means, movement and deposition of clay at bottom portion of the profile you know is quite evident and these soils are more weathered than inceptisols, but less than the ultisols and as I have already told you there widely distributed in Indian condition.

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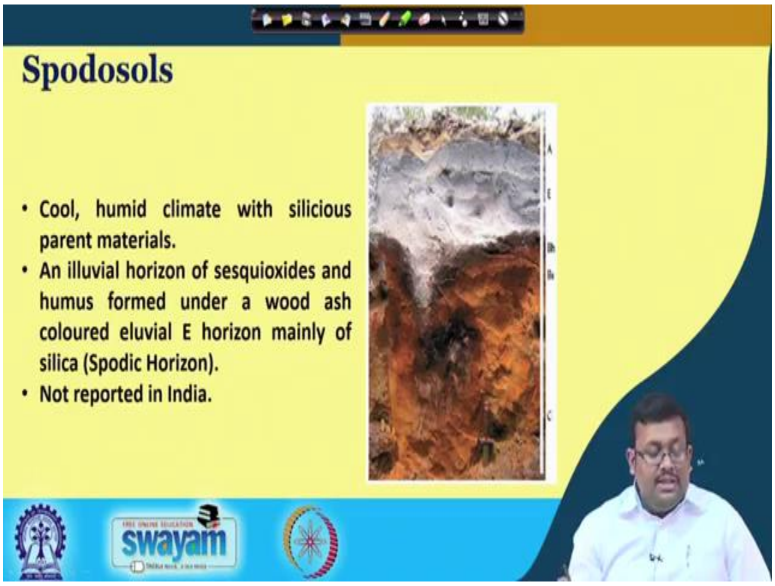

So, what is the next one? The next one is called spodosols. The spodosols we know cool humid climate they generally form in cool humid climate with silicious parent materials. They show basically an illuvial horizon of sesquioxide and humus formed under a wood ash colored eluvial E horizon. Now, you can see clearly evident that is an eluvial E horizon wood ash colored and because they are characterize by the spodic horizon and this spodic horizon is showing all the iron and aluminium oxide a move downwards living there only the silicious materials.

So, that is why they are forming this wood ash color horizon or eluvial horizon and they are generally not reported in India.

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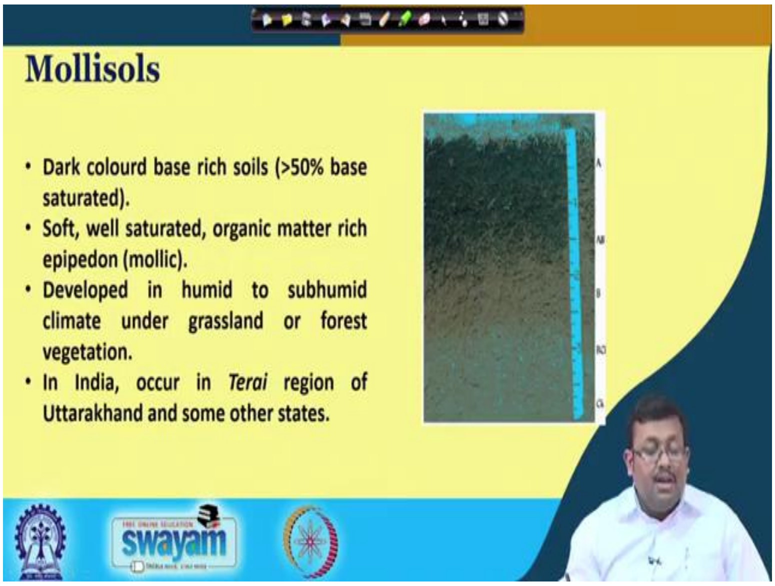

Mollisols: mollisols are characterized by the presence of mollic epipedon. They are dark coloured and they are formed they are generally formed in grassland and forest vegetation area. And, India you will see that this type of soils are basically present in Terai region of Uttarakhand and some other states.

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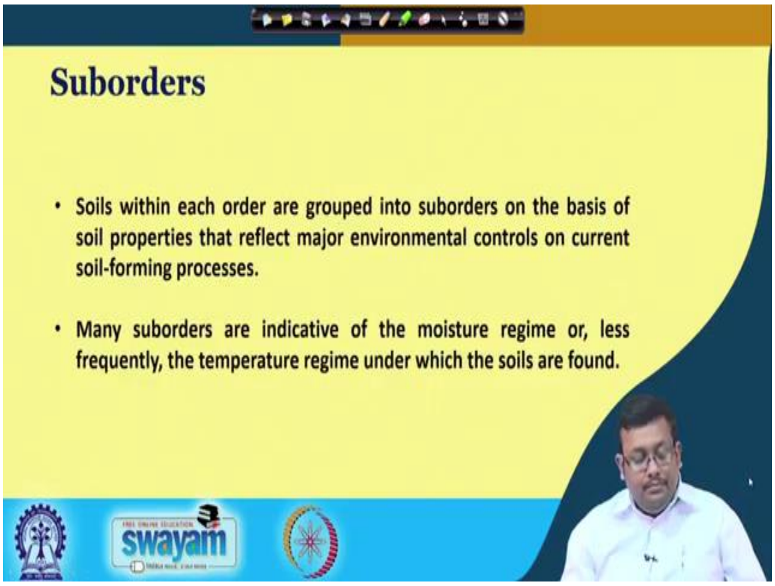

Now, since we are covered the orders let us see what are the suborders. Now, soil within each order are grouped into suborders on the basis of soil properties that reflect major environment controls on current weather forming processes. So, you will see whether there are specific you know so, specific weather impact or not that can be found from the suborders name.

Now, many suborders are indicative of the moisture regime or less frequently the temperature regime under which the soils are formed.

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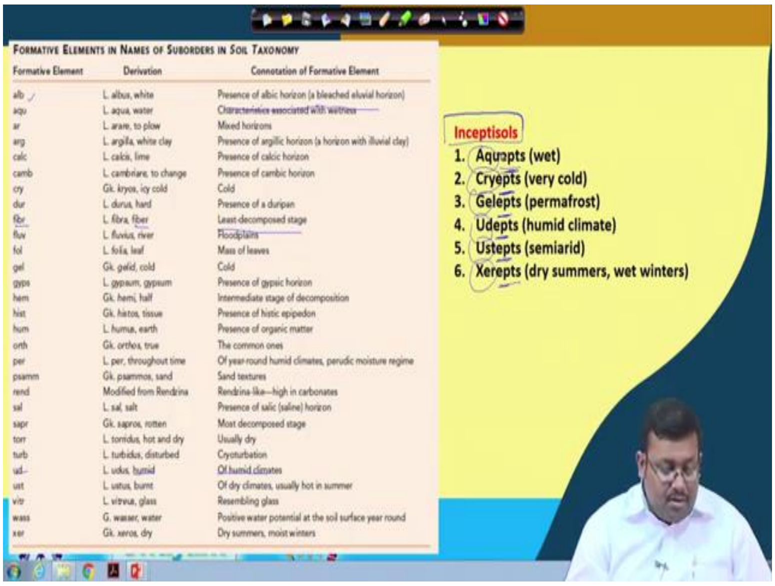

Let us see some examples. For example, you can see here I have given here lists the table which shows different formative element and different connotations of formatting element. For example, if we use alb that basically shows presence of an albic horizon which you know it is a bleached eluvial horizon which I have already told you. For example, if you if you take fibr which shows which is derived from the fiber and basically it shows the least decomposed stage of organic matter.

So, let us take you know ud which comes from humid and it shows the influence of humid climate. So, so on so forth you can see based on different formative elements, it is quite clear what are the different environmental conditions which are prevalent for forming that particular soil type.

Now, I have shown here one example let us take in example of inceptisols. Now, remember that in case of inceptisols whenever we are talking about inceptisols the formative element is ept. So, when we will see something like ept that they basically shows inceptisols. So, these ept is basically representing the major soil order and before the ept you can see these formative elements a q u, c r y g e l, u d, u s t, and x e r.

Now, a q u is basically showing wet condition, cry c r y basically showing very cold condition gel you know gellic parent material; that means, in the permafrost condition. So, it is permafrost you know it is showing in permafrost characteristics, u d e is humid climate which is shown you know humid influence I mean humid climate influence, u s t is semiarid. So, these formative elements are coming from the influence of different types of soil moisture regimes.

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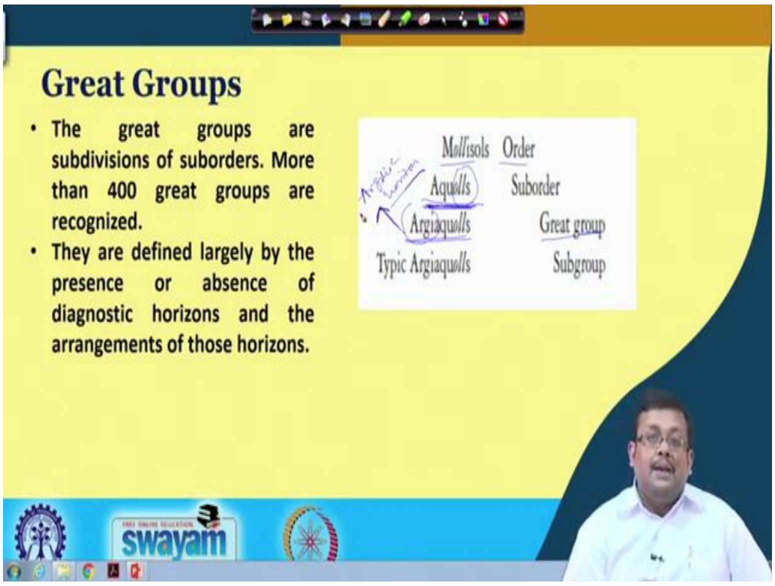

So, let us you now since we have covered the suborder let us see what is great groups. Now, the great groups are subdivision of suborders and more than 400 great groups are already recognized so far and they are defined largely by the presence and absence of diagnostic horizons and the arrangement of those horizons. For example, you can see here mollisols. So, mollisols here is an order. So, the suborder is aquolls. So, o l basically the formative element of mollisol an aquol a q u is basically showing the formative element. So, it is basically totally it is suborder, the great group is argiaquolls.

So, you can see from the name that it is a great group showing the presence of argilic horizon. Now, this argilic horizon is very important as I have already told you it is an important endopedon. So, these great group as the name suggests a showing the presence of a specific horizon, in this case it is an argellic horizon. So, as the name suggest they are defined largely by the presence and absence of diagnostic horizon and the arrangement of those horizons.

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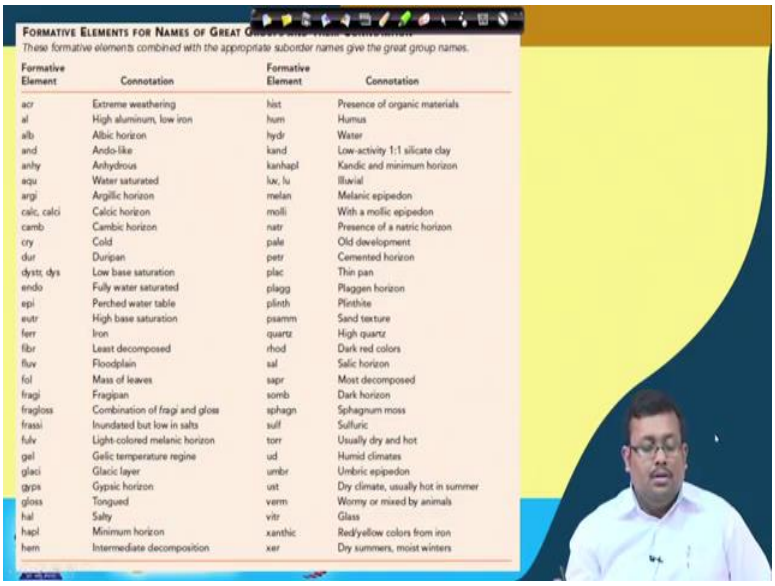

So, you know this table shows the different formative elements and which can they are connotation. For example, is you can see a c r is showing extremely weathering and then a l showing high aluminum and low iron. So, you can see these are you know s u l f is showing the presence of sulfuric horizon. You know the p l a g g showing the plaggen horizon. So, based on the presence or absence of a particular subsurface or diagnostic horizon they are naming different types of great groups.

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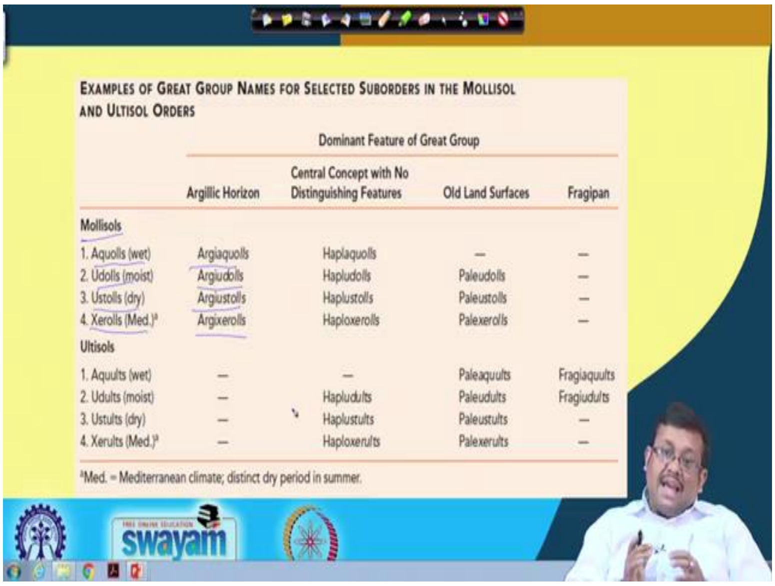

So, let us see an example of great group names for selected suborder in the mollisols and ultisols orders. So, if you see in case of mollisols let us consider mollisols. So, first of all this is aquolls, aquolls is a suborder an argillic a when there is a presence of argiaquolls it is a great group example, udolls it is a suborder then argiudolls, ustolls which is basically implying the dry condition argiustolls, xerolls Mediterranean climate argixerolls. So, it is an example of you know great group which is present in mollisols. Similarly you will find in case of ultisols also.

So, this basically shows so, let us concise. So, the highest category is order from the order we are getting the sub order which are basically showing the influence of specific weathering condition or soil moisture regime and below the suborder there is a great group which is showing the presence and absence of a particular type of horizon.

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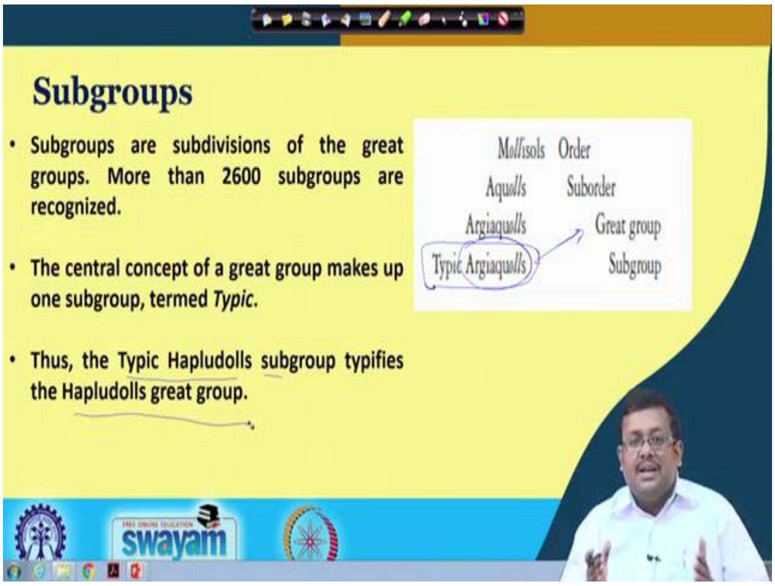

So, we have finished this great group let us see subgroup. So, subgroup are subdivision of great groups and more than 2600 subgroups are recognize. So, for at the central concept of a great group makes up one subgroup termed typic. For example, as you can see here the in our case we call a subgroup called typic argiaquolls.

Now, typic argiaquolls is basically or showing typifying the argiaquolls great group. So, this central concept of a great group makes up one subgroup. So, in that case we generally use this typic, sometime we use inter grades and extra grades when there is a mixed characteristics. So, here I have given one more example call typic hapludolls and this subgroup basically typifies the hapludolls great group

So, this shows why know what is the meaning of subgroup and how we can segregate when the we are getting a big name you know into different subgroup great group and you know suborder and individual orders.

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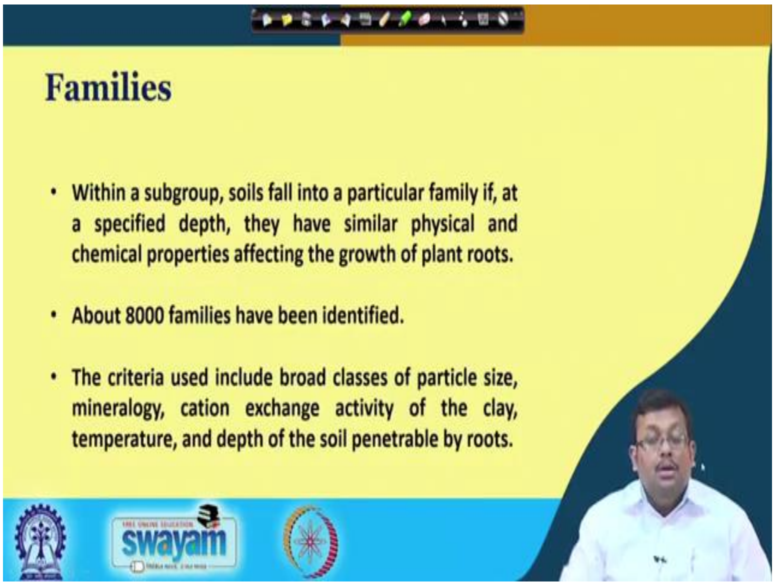

The next category is families. So, within a subgroup soil falls into particular family so, at a particular depth and they have similar physical and chemical properties affecting the growth of the plants and you know there are you know about 8000 families have been identified and the criteria used include broad classes of particle size, mineralogy, cation exchange capacity of the clay, temperature so, let us see in the next slide.

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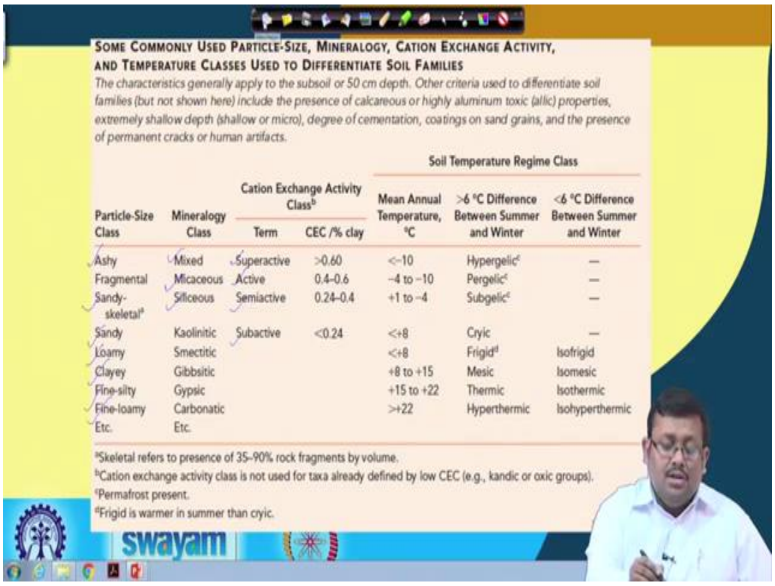

Particle-Size Class	Mineralogy Class	Cation Exchange Activity Class[b]		Soil Temperature Regime Class		
		Term	CEC /% clay	Mean Annual Temperature, °C	>6 °C Difference Between Summer and Winter	<6 °C Difference Between Summer and Winter
Ashy	Mixed	Superactive	>0.60	<−10	Hypergelic[c]	—
Fragmental	Micaceous	Active	0.4–0.6	−4 to −10	Pergelic[c]	—
Sandy-skeletal[a]	Siliceous	Semiactive	0.24–0.4	+1 to −4	Subgelic[c]	—
Sandy	Kaolinitic	Subactive	<0.24	<+8	Cryic	—
Loamy	Smectitic			<+8	Frigid[d]	Isofrigid
Clayey	Gibbsitic			+8 to +15	Mesic	Isomesic
Fine-silty	Gypsic			+15 to +22	Thermic	Isothermic
Fine-loamy	Carbonatic			>+22	Hyperthermic	Isohyperthermic
Etc.	Etc.					

I mean when you when we are defining the soil family based on particle size classes you can see there are different classes like ashy, fragment, you know sandy skeletal, sandy, loamy, clayey, fine-silty and fine-loamy. When mineralogy class, based on the mineralogy class also mixed and then micaceous then siliceous based on the cation exchange capacity also. That means, how much cation a particular soil can exchange from it is surrounding medium they have you know it can be divided into superactive, active, semiactive and subactive based on the percentage of cation exchange capacity. So, you can see based on particle size mineralogy cation exchange capacity and soil temperature regime classes we can differentiate different types of soil families. So, soil family basically contains they consider all these measurable soil properties.

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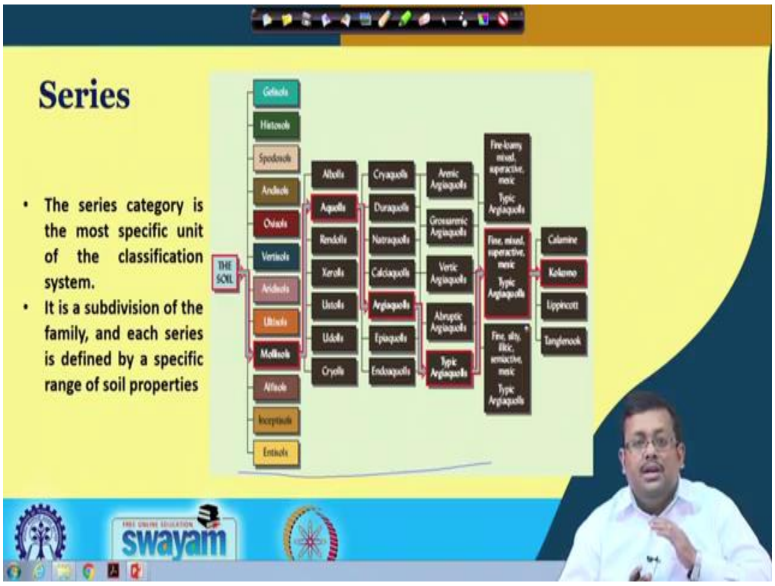

Now, finally, the soil series; the soil series category is the most specific unit of the classification system and remember that it is a sub division of the family and each series is defined by a specific range of soil property. For example, let us take an example of kokomo soil series. Now, how in this total soil you know in this total soils classification system how we can define kokomo soil series.

So, let us soil let us start with the soil and obviously, it comes within the mollisols. So, from mollisols is a major order, from there we are going to suborder that is aquolls, then great group that is argiaquolls, after that subgroup that is typic argiaquolls and finally, fine, mixed, superactive, mesic typic, argiaquolls and finally, we are getting the name of kokomo.

So, the kokomo series define by this total family name and it is specifically define by some measureable properties. For example, fine, mixed, superactive, mesic these are characteristics as I have already told you these are characteristics of the family name and then typic is basically you know typifying these argiaquolls great group. So, it is a subgroup typic argiaquolls and then argiaquolls is the great group which is showing the presence of argillic horizon, aquolls is the suborder which is showing the presence of aquic moisture regime and o l l basically showing the presence of soil order that is mollisols.

So, that is how we can define each and every soil of the world into some systematic nature, into some systematic nature you know in this into systematic way using this individual criteria or individual categories. Six different categories again soil series is the most specific and then soil family, then subgroup, great group, order and finally, soil orders.

So, we are finish the soil classification system when I hope that you have got a basic overview of soil classification and what are the basic features of soil taxonomy and what are the how we can define or why how we can name a particular type of soil. So, we have finished this soil classification.

So, let us start in new topic that is soil color and soil texture.

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So, soil color is basically indirectly tells us about different types of soil properties. Is it tells us about the soil moisture, it tells us about the you know percentage organic carbon and so on so forth and soil color is a very important soil property and it helps us to identify several soil you know. So, it helps us to I mean to make inference on soil quality sometimes. So, how you generally measure soil color in the field?

Now, generally soil color measurement in the field is done based on a chart color chart called munsell soil color chart and this munsell soil color chart helps in precise and repeatable interpretation of soil color. And, these munsell soil color chart basically you know realize on three important criteria of color one is called hue, another is called value, another is chroma. Now, in the next slide we will see what are they, I mean what these terms actually represent.

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So, in the munsell soil color chart is basically book. So, if you open the book you will see several pages with different chips of colors. So, this color chips basically indicates the soil color and based on the based on the proper matching of our soil with this color chips basically name that particular soil.

So, if you open up a munsell soil color chart a particular page you will see this type of notations, you can see here 2.5 YR. So, this is called hue. Hue basically shows redness or yellowness of a soil or in other words is based on the dominant spectral color. So, hue basically shows the redness and yellowness of a soil and basically represent dominant spectral color.

So here 2.5 YR is a specific hue which is shows somewhat integrate between yellow redness, yellowish on redness and you will also find another criteria called value another variable called value and; obviously, value will be increasing from top, increasing from we know as you can see in this munsell soil color chart value will be increasing from bottom towards the top. So, you can see 2.5 and then 3, 4, 5, 6, 7 and 8.

So, basically value shows the degree of lightness and brightness. So, lower values basically indicates darkness and higher values basically indicates brightness of a soil and the third criteria is called chroma which is showing the intensity or brightness or in other words the purity of the color. So, the chroma increases from 1 to 8 and it increases from this side to this side, so, left to right. So, as you can see you are increasing the chroma the purity of the color is somewhat decreasing.

So, these basically shows using this three different categories or three different variables we can define a particular soil color. For example, if we define as I have shown you if we name any soil color as 2.5 YR 4 by 4 that define basically says that this soil has a hue of 2.5 YR with a value of 4 and a chroma of 4.

So, basically when we takes out a particular chip, you know particular soil particular you know some soil we generally measure, we generally compare the soil color with individual chip. And from this individual chip we identify what is the actual hue, what is the value and what is the chroma and based on that we named as individual soil color. So, I hope that now it is clear you know how we name different soil color. So, let us see what the basic implication of soil color are.

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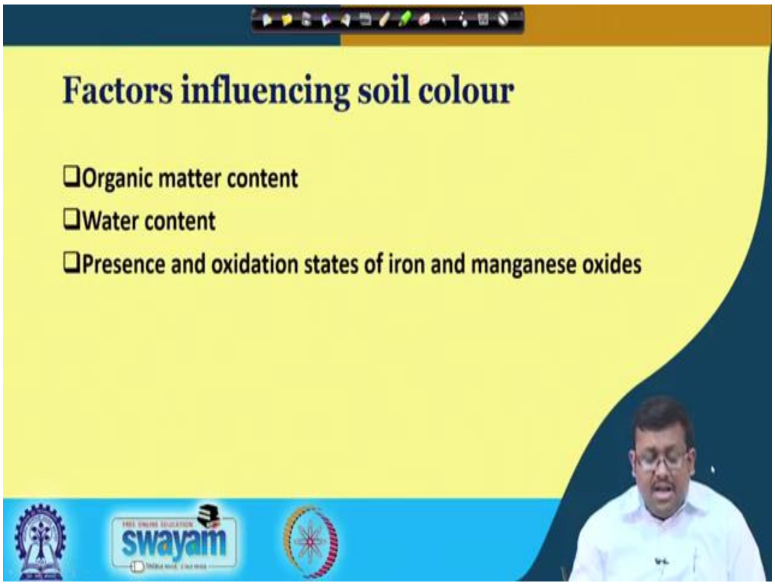

Now, different factors influence soil color. For example, based on the percentage of organic matter content soil color would be different, water content plays an important role in soil color. So, that is why whenever you are measuring the soil color it is almost important to write down the wetness condition and also presence and oxidation states of iron and manganese oxides a very important from the soil color point of view is.

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So, as you can see more organic matter you showing darker soil color or low value here and also in the right most picture in this picture we can see more water you know the left picture is showing more organic matter, showing the darker soil and low value and the right most picture is showing the more water which is creating darker soil color of low value. So, it is very important you know the soil colors shows a snapshot of soil organic matter as well as soil moisture percentage.

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Here you can see based on different types of oxidation reduction stage. So, obviously, here these are oxidized zone and these are reduced as you can see from the color difference. So, red and brown are basically showing iron in oxidized form or high chroma and grey and blue zones just like these are showing the iron in reduced form a low chroma. So, based on this oxidation reduction of iron also the color varies and their value and their chroma also varies.

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So, you can see there are two different types of soil one is gleyed soil and mollic epipedon. Now, gleyed soil basically showing the moisture water logged soils. So, these are showing different colors and mollic epipedon are very dark in color and you know obviously, the presence of high organic matter you know where has a great impact on their color. So, in case of warm and reddish soil, tropical dark grey and browns and all these soils are showing different types of soil color based on different climatic conditions.

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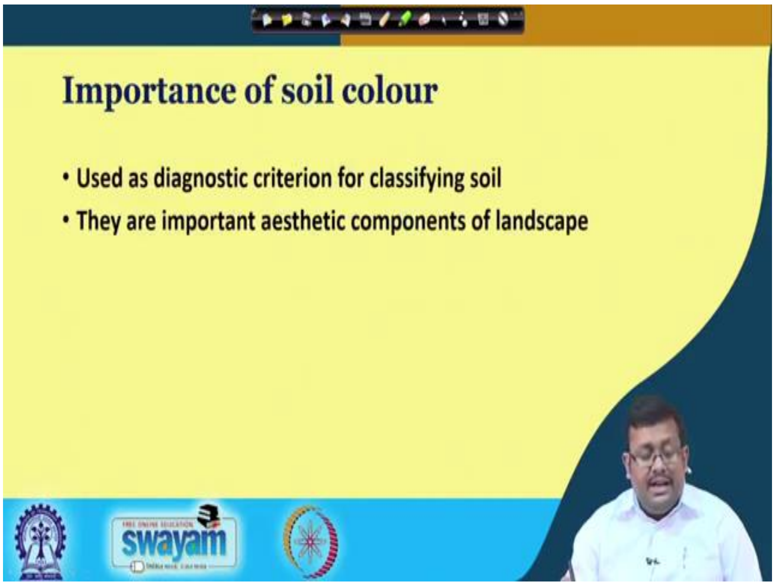

And, what are the importance of soil color; obviously, the soil color are used as an you know diagnostic criterion for classifying soil and obviously, they are important aesthetic components of the landscape because you know most of the you know red soils or you know most of the soils which are dominated by iron and aluminum oxides are showing red color.

So, it is very important to examine the soil color before we go for you know other soil physical property measurement. And, again soil color shows you know a snapshot of different properties and it helps us to interpret different soil properties specifically the presence of organic matter or moisture. And, there is nowadays scientist of develop several image based you know cheaper image base in you know instruments which are helpful for quantitative estimation of soil color.

Because, using the munsell soil color chart it is kind of qualitative and it is subjective because it depends on the perspective of the investigator who is giving the name. But, now soil scientist at have developed several chip image based soil sensors which can quantitatively measure different soil colors. And using this quantitative measurement of soil color they can predict different soil properties specifically soil organic matter.

So, let us wrap up here and from the next lecture will be starting soil texture and then will be covering soil structure.

Thank you very much.