Irrigation and Drainage
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Lecture – 53
Non - Conventional Drainage

So, this is the lecture number 53 on Non Conventional Drainage systems. So, the previous slides we have been talking about conventional drainage systems, where this surface and subsurface drainage systems, such as you know open ditches and tile drains so, but some places where these systems are costlier. So, then someone has to go for non conventional drainage systems.

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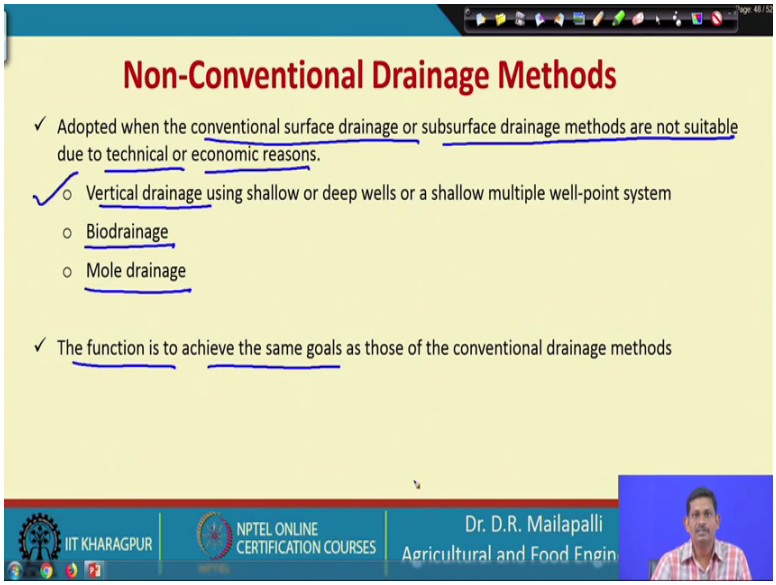

So, we are going to see in this lecture, most of what are those non conventional drainage systems? So, here so this is basically adopted when the conventional surface drainage system, subsurface drainage system methods are not suitable due to technical or economic reasons. So, basically so these conventional or non conventional drainage systems are classified into vertical drainage, biodrainage and mole drainage.

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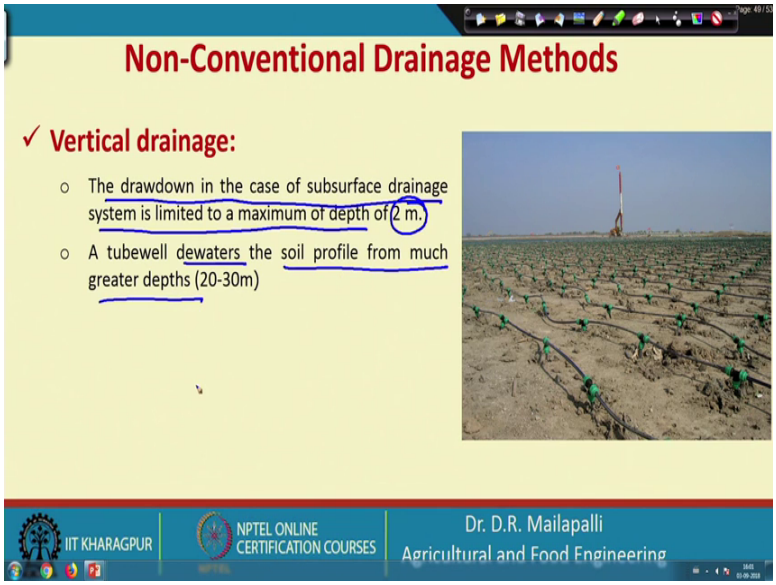

So, these basically these 3 drainage systems non conventional drainage systems, we are going to discuss in this lecture. So, the so, basic function is to achieve the same goal as that of your conventional drainage methods. So, removing excess water from the root zone so, that is the main objective or in case of even in non conventional drainage systems. So here, if you see the vertical drainage, this is the number 1, we were talking about. So, what in case of vertical drainage system? So, the draw down in the case of subsurface or drainage system is limited to a maximum depth of 2 meter, in case and the tube weld deep waters, the soil profile from much greater depth 20 to 30 meters.

So here, in this picture if you clearly see so, the vertical drainage so like for example, this is 1 well and this is 2nd well, 3rd well, 4th well. So, the field consists of series of wells and all wells are connected and pumped, I mean the water is being pumped from the subsurface ok. So, this is the advantage here, but maximum you may achieve you know 2 meter maximum depth and but in case of you know the tube wells. So, generally tube wells can go up to 20 to 30 meter and deep water. So, this is the another I mean dangerous like you can also tap the ground water in case of in addition to your you know drainage water ok.

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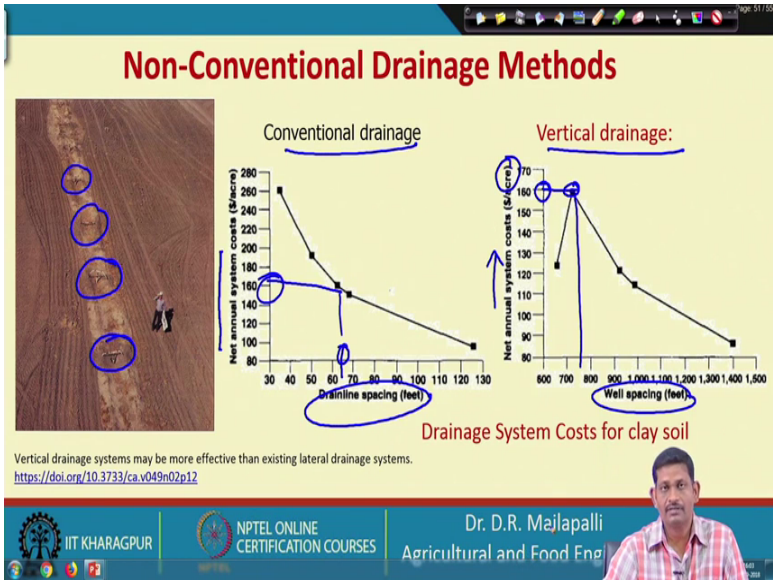

So, and so the basically, in the vertical drainage will be using the tube wells to remove the excess water from the root zone ok. So here, in this example or in this picture if you see so, this is one tube well and this is one another tube another tube. So, series of tubes which is installed in the field to remove excess waters and all tubes are connected. And finally so, that will be I mean, the water which is from the subsurface will be removed and then for example, here the cost estimation if you see the conventional drainage and a vertical drainage. So, the drain spacing and here the well spacing and on y axis net annual system cost in dollar per acre and net annual system cost in dollar per acre.

So, generally for drain line spacing so, for economically so, this is 65 feet will be more economical like drain line spacing. So, correspond to that you get 160 dollars per acre. So, for 160 dollars per acre here so here, this is a maximum you get you know even you can increase the well spacing right well spacing in feet's ok. So, for this same acre like in 1 acre so, you can for 160 dollars with 160 dollars.

So, you can you know a vertical drainage could effectively work compared to the conventional drainage ok. So, and then so, this is related to the clay soil and which is taken from the California Agriculture Journal, I mean basically the study was taking place in UC Davis Campus ok. So, the vertical drainage has economical benefits, were than the conventional drainage and that is and because, it requires you know less number of you know wells and less cost, but the thing is the operational cost will be more. Because, so the vertical drainage also requires a pump to remove water whereas, the conventional drainage may not require any pump ok.

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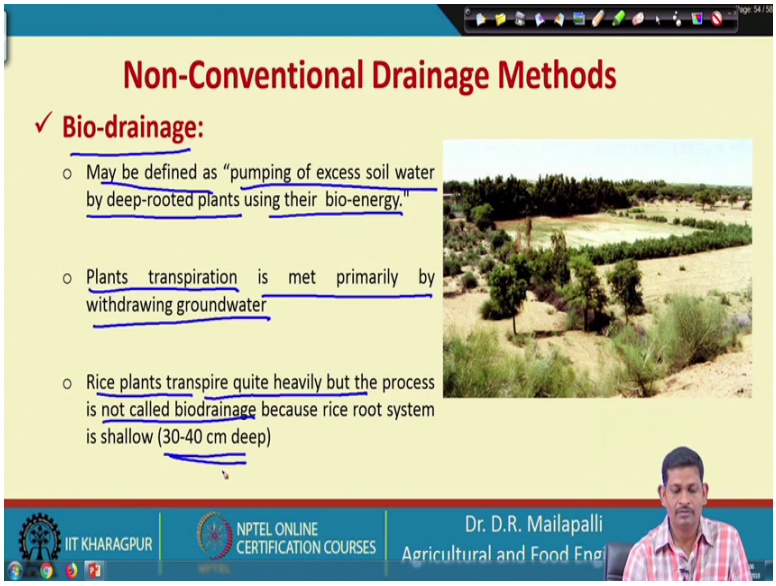

So, this is the and then the bio drainages so, the bio drainage the basically going for plantation right in bio drainage. So, the plants are grown the plantation crops or the trees are grown in the area of an area of you know drainage problematic areas and that will have deep rooted plants will remove the water through evaporation or evapotranspiration ok. So, this may be defined as pumping of excess soil water by deep rooted plants using their bio energy ok.

So, because the bio energy in the sense so, the solar energy basically will help in taking the water from the deep rooted to the atmosphere so, through evapotranspiration. So, the plants transpiration is met primarily by withdrawing ground water and rice plants also transpired quite heavily, but the process is not called bio drainage. Because, so the roots are approved I mean confined to 30 to 40 centimeter deep so, it is a shallow roots.

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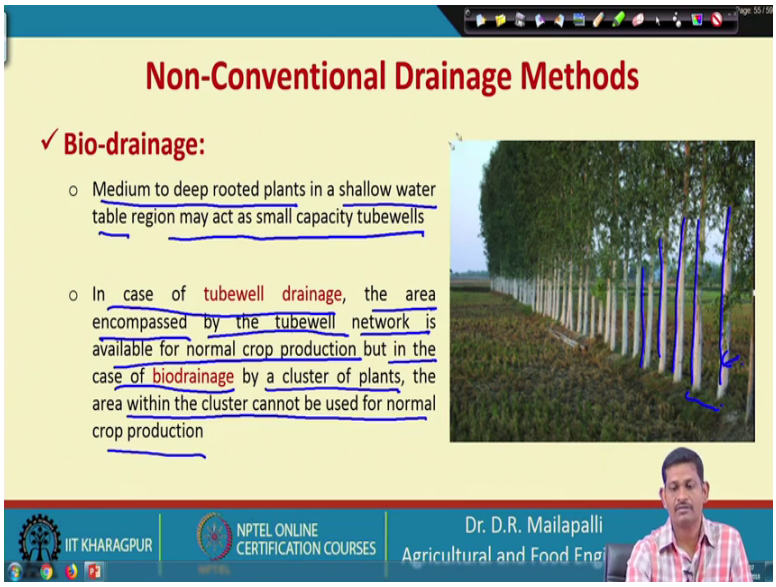

So, generally we do not call it as a bio drainage in case of rice plants. And so the next is, so bio drainage is remained the medium to deep rooted plants in shallow water table region, may act a small capacity to bail so, similar to in case of vertical drainage. So, it is so each tree here so, these are I mean each tea tree could be acted as a tube well right, which because it removes water from the subsurface. So, in case of tube well drainage, the area encompasses by the tube well network is available for normal crop production right, but in the case of bio drainage by cluster of plants, the area within the cluster cannot be used for normal production ok.

So, this is the main difference, if you are talking about the vertical drainage and bio drainage. Bio drainage in case of vertical drainage so, since the tube wells are installed within the, you know the crop area. So, you can still use the crop area for crop production so, but whereas, in bio drainage the trees are being now planted or that acts as vertical, you know tube wells. So, a vertical drainage so the I mean so the cluster or may not be because the cluster may not be used for our production. So, that is the difference in case of bio drainage and vertical drainage.

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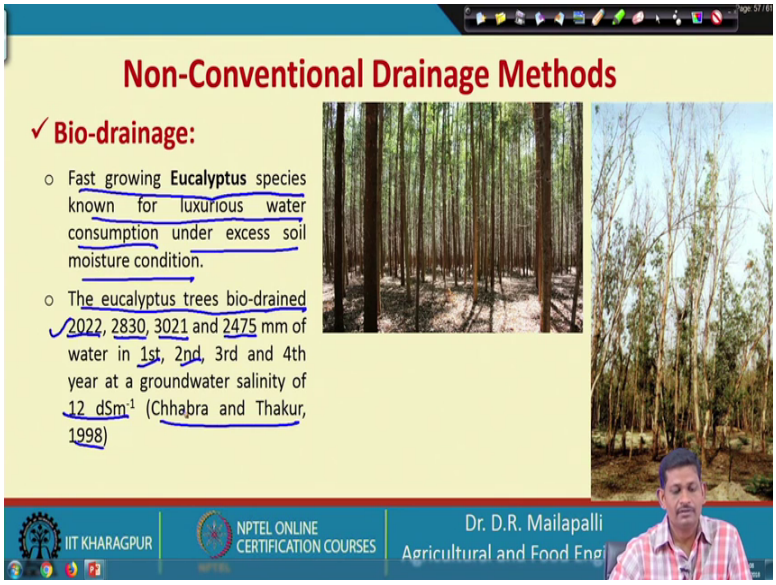

So, here in case of bio drainage, the fast growing eucalyptus species known for luxurious water consumption, under excess soil moisture conditions. So, eucalyptus is the best example, in remove removing you know of water from the subsurface ok. The eucalyptus trees bio drained around, you know 2000 mm and 2800 mm, 3000 mm, 2400 mm of water in 1st, 2nd, 3rd and 4th year of groundwater salinity of 12 dc 7 per meter. So, this is done in pi Punjab Irrigation University.

So, this is basically, the eucalyptus trees bio drainage, bio drain acts as a bio drains and which will remove 2000 mm of rain falls in a 1st year, 2nd year 3rd year, 4th year. So, on an average so it removes, around 2500 mm in a year.

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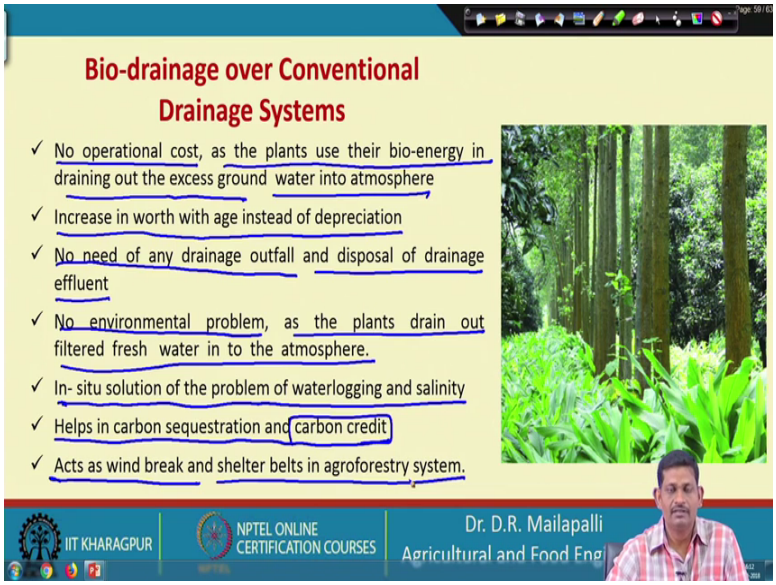

So, that is a good amount right and then so, the next is bio drainage over conventional drainage. So, what is the advantage of bio drainage over conventional drainage? Here in case of bio drainage, no operational cost as the plants use their bio energy in draining out the excess groundwater into the atmosphere. So, in case of bio drainage, you do not require any pump or anything to remove water, that cost really excess you know cost that that really, but since it does not, cost no operational cost involved because once, it is growing it will grow continuously right. So, increase in worth with age instead of depreciation.

So, as the plantation grows you know so, the worth of the plantation will increase, because it grows faster and that can be used to sell, that can be used as a timber material right and that will give an excess you know economic or extra economic. So, no need of any drainage outfall and disposal of drainage affluent. So, in case of conventional drainage, you have to dispose the drainage water, but whereas, in case of bio drainage you do not require such kind of you know outfalls ok. So because, this is the through evapotranspiration so, the water will be like the excess water will be thrown away to atmosphere.

So, no environmental problem as the plants drain out filtered fresh water into the atmosphere, this is a very good you know the indicator of environmental friendliness, because it filtered out the whatever, you know metal heavy metals whatever it may be. So, the fresh water will be I mean, fresh water will be thrown into the atmosphere not in case of conventional ok. So, in-situ solution of the problem of water logging and salinity so, this is the in-situ solution. So, bio drainage gives an in-situ solution of removing excess water in salinity problems ok. So, helps in carbon sequestration and carbon credits.

So, since the plant is growing so, it absorbs carbon dioxide. So, that reduces the carbon load in the atmosphere so, that will give the carbon credit alright. So, access windbreak and shelterbelts agro forestry systems. So, since it is a biological strip or filter stray or the plantation strip. So, the this definitely will help me in breaking the wind right reduces the wind erosion and all other things.

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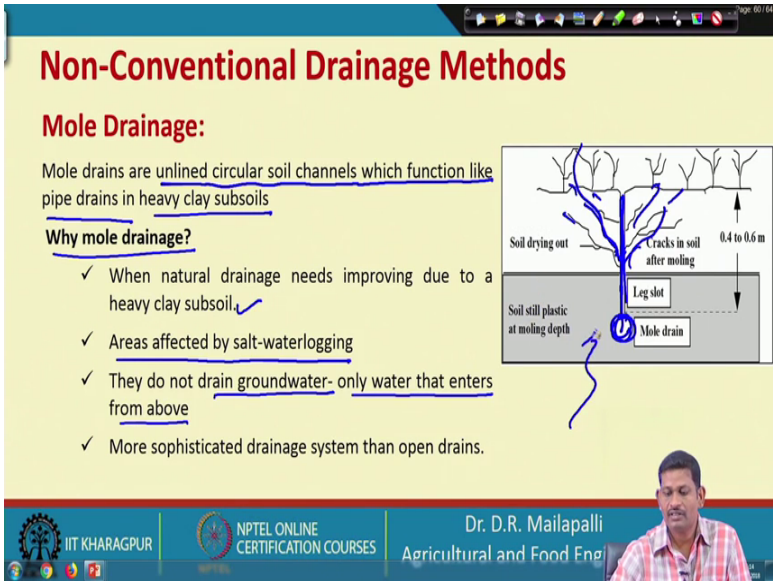

So, and then 3rd one is the mold rain is ok so, the third one is the mold rain is so, the mole drainage in case of. So, the basically the mole drainage are online circular soil channels, which functions like a pipe drains in heavy clay soils weakly sub soils. So, more drained we already talked about this in the previous lectures. So, basically this is kind of drainage so, this is unlined in heavy clay soils. So, if you see this so, this is a channel, which is made by mole right and then the this is the mole drain and then the leg slot, which is also it is kind of a cutter right. So, in that is really important, because that will break the you know soil and have the channel. So, whenever water is falling so, the water will take these channels and get into the mole drain ok.

So, here why mole drain is? So, when natural drainage needs improving due to heavy clay subsoil ok. So generally, what happened in of in case of clay soils? So, the machinery the regular conventional drainage machinery cannot be useful in making the channels ok. So, requires a specific or special kind of the drainage machinery so, that is a mole drain and the areas affected by salt water or logging. So, where the areas which are affected by salt water logging? So, that is also required mole drainage, they do not drain groundwater only water that enters from the above.

So, this is because, this is a clay soil. So, the groundwater entry into the system, may not be possible only the water which is falling on top right, which is falling on top will take this fractures as pathways and meet into the drainage not from you know the groundwater and more sophisticated drainage system, then other drain source. So, since it requires a special kind of machinery like a mole plough so, this is a sophisticated drainage system right.

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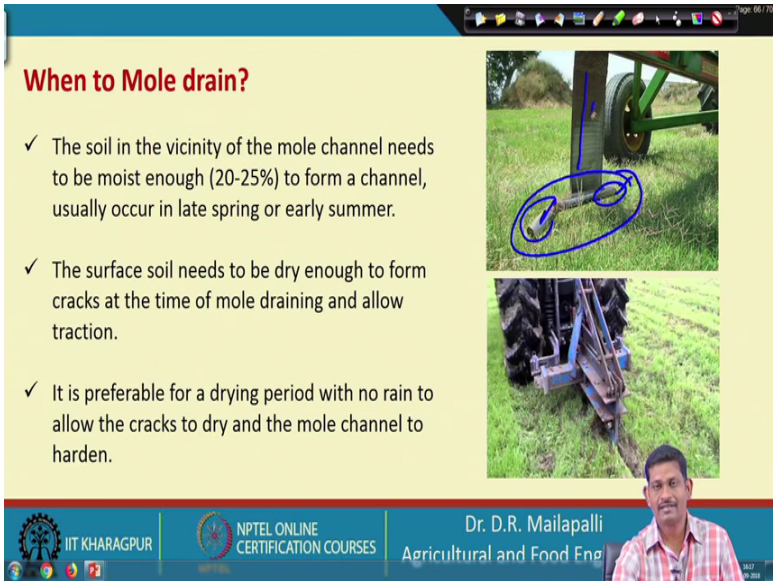

And then so, the next is went to mole drain. So, the mole drain is practice in a particular, you know seasons so, that they catastrophe due to I mean the drainage would be minimized ok. Here the soil in the vicinity of the mole channel needs to be moist enough right so, that is around 20 to 25 percent of clay percent as a moisture should be present in the clay soil in subsoil right to form the channel and usually occur in late spring and early summer. So, in early summer and late spring so, this may be possible right so once, it is summer, what happens the soil may not have enough moisture so, that may be less than 20 to 20 percent.

So, when it is dry it is very difficult to run the mole plough. So, then the surface soil needs to be dry enough to form cracks to the time of mole drain improve traction ok. So here, 2 things so our sub, I mean subsoil and surface soil. So, surface soil and subsoil ok so, subsoil is used to is required to make channels various surface soil. So, once it should so, this should be moist right. So, this will be moist, where this should be a little dry so that, what happened? There is a formation of cracks so, cracks formation is very important. So, we required it because that will give a, you know pathways for the water to enter into the channel ok. So, then it is preferable for drying period with no rain to allow the cracks to dry and the mole channel to harden ok.

So generally, what happened? The main preferable period will be drying period. So, drying period in the sense not exact in summer, but you know in between you know dry spells we can say. So, the no rain to allow the cracks right and to dry and the mole channel to harden it so, this is important. So, here the pictures are showing the mole plough so, it looks like this is the mole plough. So, it has a bulleted you know bottom and then this will make channel basically, this will make channel and then this will compact the or the shape the channel and this one basically, the chisels the is top surface, I mean the surface or it makes the cracks you can say ok. So here if you see the channel, how it is making?

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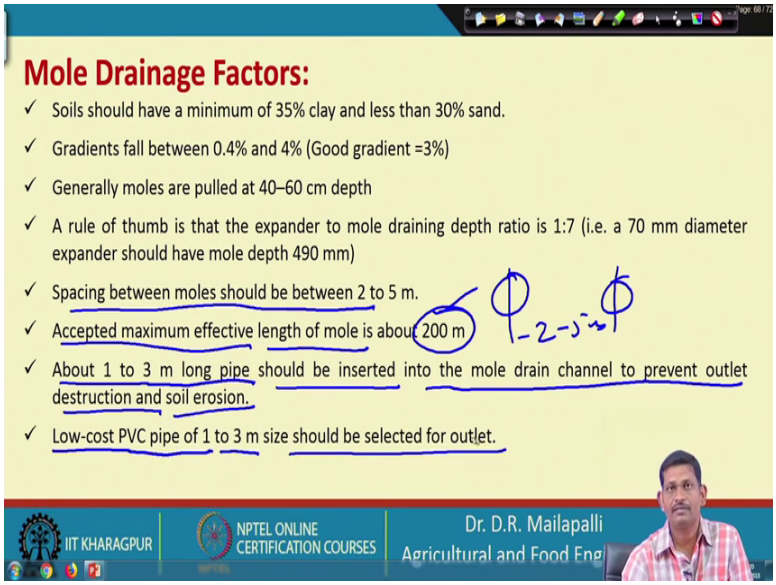

So, mole drain is factors or soil should have a minimum 35 percent clay and less than 30 percent sand ok. So, the I mean the soils, which are suitable for mole drainage should have 35 percent clay and less than 30 percent sand and gradients fall between 0.4 to 4 percent right. So, good gradients will be 3 percent grade, we should maintain so, that water can easily transport from one end to other end. So, or water can flow from one end to other end generally, moles are pulled at 40 to 60 centimeter depth. So, this is not so deep it is more most of the crops can be covered here for the 60 centimeter and a rule of thumb is that expander to mole drainage depth ratios 1 is to 7 so; that means, so, if you are going for 70 mm diameter expander, should have a mole depth of 490 mm. So, it is like, if this is 70 mm right, 70 mm expander so, then the depths should be around 490 meter depth ok so, that is the thumb rule.

And spacing between moles should be between 2 to 5 meter right. So 2 moles, so you have a spacing between 2 moles, a moles drains will be 2 to 5 meter and acceptor maximum effect length is a 200 meter, in some cases it can go up to 400 meter also so, but mostly the effective length will be 200 meter. So, about 1 to 3 meter long pipe should be inserted into the mole drain channel to prevent outlet destructions and soil erosion. So, at the outlet because insides ok, but outlet is very important to get all water out safely right. So, around 3 to 4 meter long pipe is inserted in the out outlet right. So, that the water will be safely come out and without collapsing the channels and low cost PVC pipe of 1 to 3 meter size should be selected for outlet.

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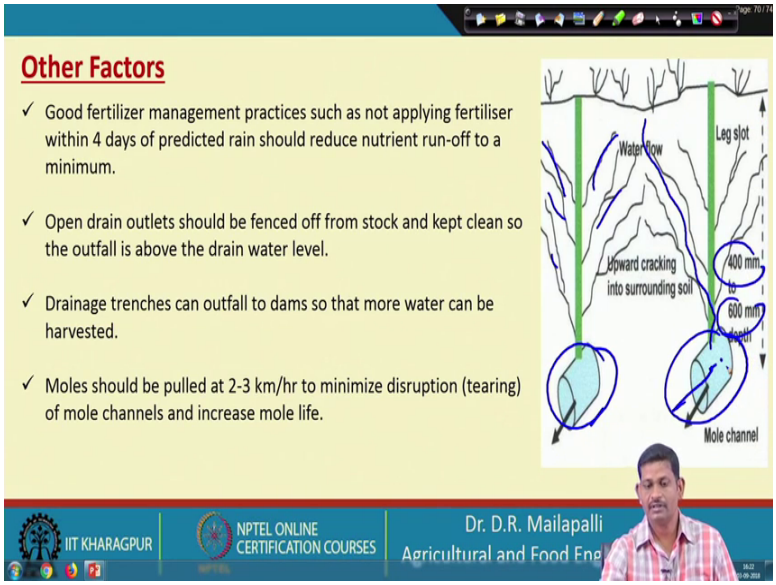

So, mostly the PVC pipe is been used for outlet. So here, if you see there are some other factors like good fertilizer management practices, such as not applying fertilizer within 4 days of predicted rain should be means, should reduce the nutrient runoff the minimum ok. So, fertilizer applications should be taking care of while designing right, while taking a while I mean removing the water. So generally, the fertilizer I mean application will be taking place like; you know 4 to 4 days off predicted rain right, 4 within 4 days of predicted rain. So, that the fertilizer may not be transported or may not be runoff from the fields like, open drain outlets should be fenced off from the stock and kept clean. So, the outfalls is, above the drain water level so, this is very important the open drain outlets so, that should be fenced so, that it can avoid allowing the animals and other things and also so also what happened? So, that will keep the drain base above the water level ok.

So, the drainage trenches can out fall to dam so, that more water can be harvested. So, some sometimes more drain trenches, drain trenches can be out fall to a dams. So, that more water can be harvested right, to the drains and moles should be pulled at 2 to 3 kilometers per hour. So, this is a speed of machine to make channels to minimize the disruption or tearing of mole channels and increase the more life. So, this is 2 to 3 kilometer per hour pulling velocity or the minimum to avoid disruption right and also increase in the mole life and here, if you see in this picture. So, these are the mole these are the mole channels right, mole cells and these are the cracks.

So through, which water is going to flow and pass through this and the leg slot length 400 to 600 meter depth right, 600 mm right and the next is so. So this is all about these non conventional you know drainage systems.

So, the basically has three types, one is vertical drainage, bio drainage and mole drainage. So, in case of vertical drainage, we mostly use the tube wells to remove water, but it requires pumps, it requires you know pumps to remove water from wells and compared to conventional drainage. So these vertical drainage is economical, but the operational operation cost is you know, more compared to converse drainage. And then the bio drainage so, removing the excess water by planting you know plantational crops ok. So here, best example is eucalyptus plant a eucalyptus trees so, they can go deeper

and then remove water around or 2500 mm, you know from you know the agricultural lands.

So, the bio drainage is advantageous than conventional drainage, because it does not require operational cost and since it is the natural growth. So, over a period of time so, you get economy on that and you get profits by selling the you know timbers or the tree. So, and also it helps in carbon sequestration and carbon crediting and also the pollution wise, it is less it is no pollution because, the water is been filtered from the surface and remove and then thrown into atmosphere ok.

So, then the other one is the mole drainage, in mole drainage is generally, practiced in heavy clay sub soils. So, it has a particular I mean mole plough so, that will make channel and then their cutting tool, I mean the lay log right. So, that makes the channel from the surface so, the cracking will be happened like, the cracks will be formed in the surface and subsurface there is a channel.

So, the water enters through the cracks and fill the you know mole channels ok. So then, mole drainage generally, practiced in you know draining, I mean dry periods dry spells. So, that the cracks or I mean the cracks on surface or not collapsed at the same time, the channel is not getting too much wet. So, generally, 20 to 20, you know 5 or 20 percent, 22 to 20 percent moisture, we expect in the subsoil in a clay soil whereas, in the top, we expect you know dry soil. So, that that can make it is not too much dry, but it is a relatively dry so, that you can have clear channels.

So, overall the conventional or drainage systems or less I mean cost or less operating cost, I mean comparatively the conventional drainage systems. So, these are used when, there is I mean, when there is no provision to operate the conventional drainage systems.

Thank you so much.