Forests and Their Management
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Module – 10
Silvicultural Practices
Lecture - 29
Nursery Techniques

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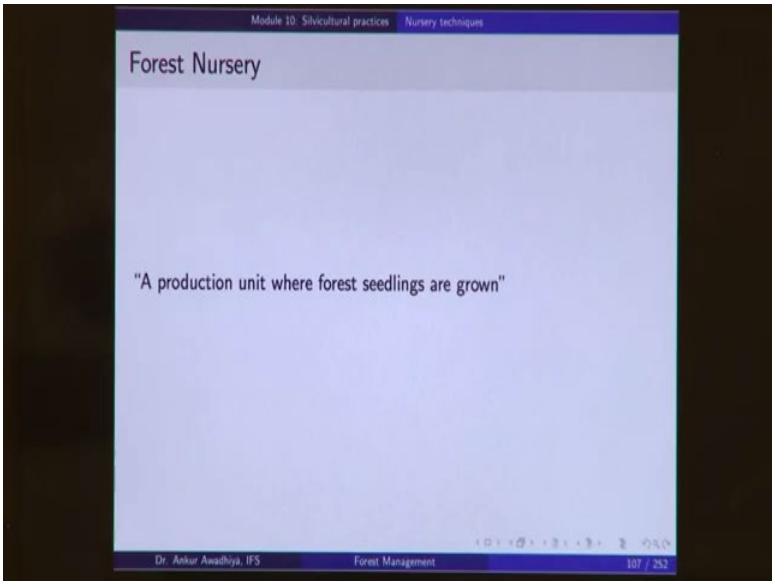

[FL] We carry forward our discussion on Silvicultural Practices. And, today we will have a look at Nursery Techniques. So, what is a nursery? A nursery is a production unit, where forest seedlings are grown. In our case, we are only talking about the forest nurseries. We are not talking about horticultural nurseries or agricultural nurseries. So, in the case of a forest nursery, it is a production unit; it means that the major objective of setting up a nursery is to produce things.

It is not a research organization; it is not for any other purpose; the primary purpose is production of seedlings. So, it is a production unit, where forest seedlings are grown. Now, the question is we know that we can raise plants from seeds; so, why not just go into the forest area those areas, where you want to do the afforestation and just disperse the seeds there.

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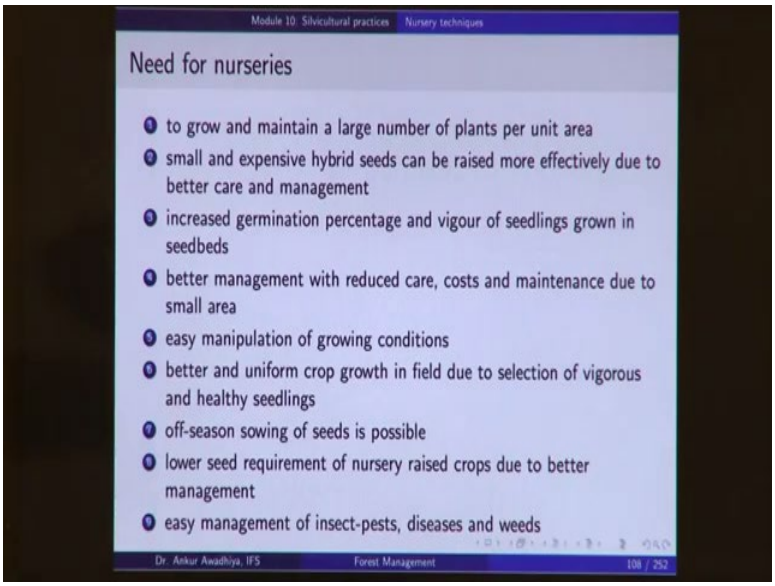

What is the importance? why do we need to have a nursery? This is because the nursery provides us with certain advantages. So, what is the advantage of raising the plants in a nursery via via raising the plants directly on the field? The need for nurseries! The first is to grow and maintain a large number of plants per unit area, because a nursery is a small place and you can do very intensive management in that small area. So, it is possible to grow a large number of plants in a very small area.

Now, area or land is a very pricey commodity and when you want to have a large number of plants in a small area; to produce a large number of plants in a small area, you need to do an intensive management. And, the place where you do this intensive management is the nursery. Small and expensive hybrid seeds can be raised more effectively due to better care and management.

Now, because you have a small area, a more intensive management. So, it also means that the raising of plants is much more effective; is much better, when we are doing this operation in a nursery as compared to doing this operation out in the field. Then, increase germination percentage and vigour of seedlings grown in seed beds. Now, in the case of a nursery, we make seed beds, we provide those conditions, which are optimal conditions for germination and for the growth of plants.

So, this results in a much better or increased germity germination percentage and also the vigour of seedlings. Now, vigour refers to the hardiness of the seedling, and also the rate

of growth that it will show once you have planted it out in the field. Now, because in a nursery, the plants get the most optimum conditions, so, they put up a very fast growth and once they once they have shown this fast growths. Once they have become hardly enough to put them out in the field, then in the field as well, they will be showing a very fast growth.

So, the vigour is much better, when we talk about plants that are raised in the nurseries. Better management with reduced care, cost and maintenance due to small area. Now, let us consider two scenarios; in one, we are enclosing a small area and we are making a nursery. And, in the second one, we are doing the - we are raising the plants out there in the field.

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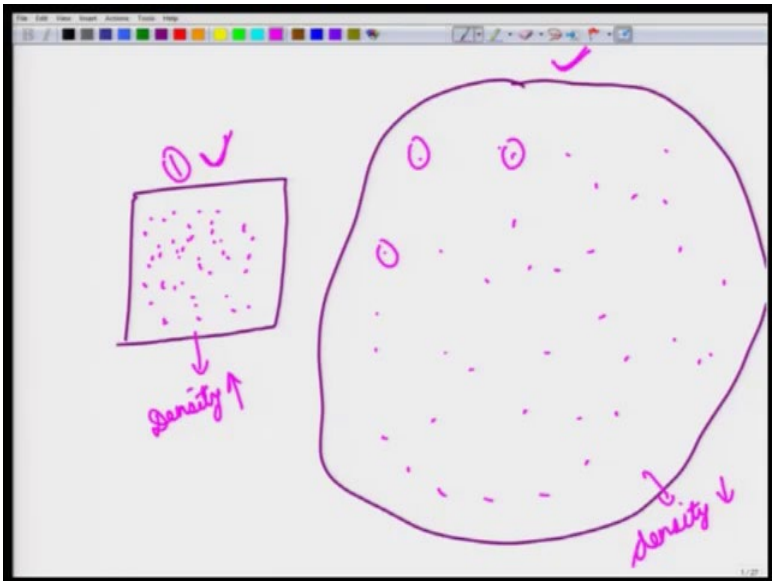

Now, let us say that we are raising say 1000 plants here. Now, because of intensive management, you are having a much greater density of plants, whereas, if you were to raise these same number of plants out there in the field, the density would have been much lesser. So, this has a higher density and this has a lower density. Now, let us consider some management intervention that we will need to provide to these young seedlings that are growing.

Let us say that we will that we will that, we need to provide water to the plants. Now, in this scenario; in the case of a nursery, because this area is a small; so, it is much cheaper to provide water, whereas, in the case of the forest area, you will have to traverse long

distances to give water to each and every plant. But then, giving water is not the only intervention; you will have to do weeding as well, so that your plants that have germinated are not out competed by the weeds.

Now, when you want to do weeding is typically a very labour intensive job. Now, in the case of this is small nursery, the people can come to this area a large number of people can come into this area and do this weeding in a very time efficient manner. Whereas, in the case of raising the plants out in the field, the person would have to go here then here then here and. So, it becomes very much time consuming just to traverse these larger distances.

Consider another management intervention; application of fertilizers. Here, again in the case of a field scenario, the persons will have to traverse long distances; similarly application of insecticides or pesticides. So, when we talk about the nursery, the management is much better with reduced care cost and maintenance due to the small area. Because the area is small, and in this small area, you are raising a large number of plants. So, per plant cost; per plant maintenance goes down, easy manipulation of growing conditions.

Now, there are some plants that require some manipulation in the growing conditions; such as in the very early stage of their lives, especially if it is a shade bearing plant. So, this plant would have to be provided with some amount of shade. Whereas, later on this plant, probably will be requiring more intense sunlight. Now, in the case of a nursery, because you are growing these plants in a smaller area; so, manipulation of these growing conditions is very easy, because you can very easily put up a thatch roof or say a shade net on top of those seedlings that need to be provided with the shade. So, manipulation of the growing conditions is very easy.

Better and uniform crop growth in the field due to selection of vigorous and healthy seedlings.

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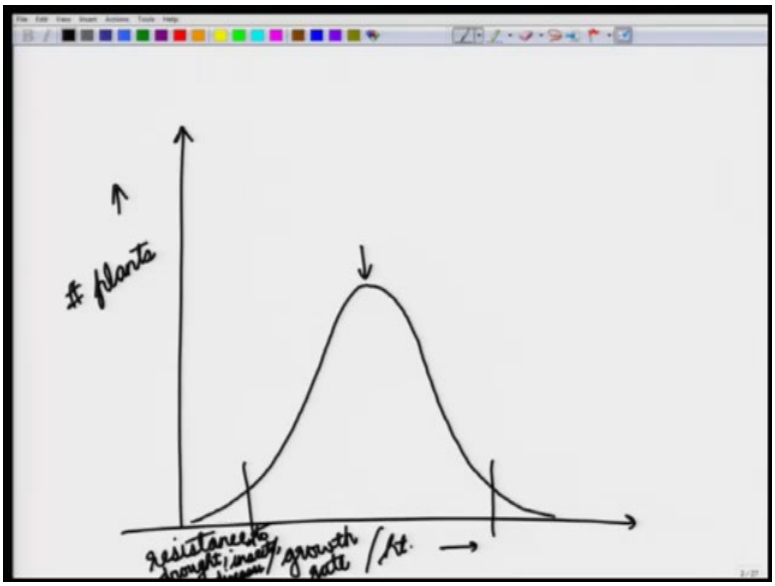

Now, in the case of any growth, if let us say we plant we plot the number of plants versus height; typically, when you are when you are you are using seeds to you to make these plants these plants would show a curve like this.

So, this is like the average height of the plants; but then, there will be some plants that show a very low height and there will be some plants that show a very great height a large height. Now, this is very similar to what we see even in the case of human beings. All of us have different heights, but then we can say that for any race there is one standard average height, but then we also find in the population that there are some people who have a lower height and some people they have a higher height.

Now, in the case of plants as well, if you look at any parameter - be it height be it growth; so, let us say the growth rate, there will be some plants that grow at the average rate there will be some plants that grow very fast; there will be some plants that grow very slowly or let us say resistance. Now, this can be resistance to, say draught or insects or diseases. Here again, you will find that most of the plants will be having an average resistance some will be very highly resistance some will be very low resistance.

Now, when you are growing these plants in a nursery, it is possible to do a grading of these plants and then, select the best plants for sending out at the field. So, for instance, if you are going for production forestry, you want to have plants that grow at a much faster pace. So, in the nursery when you are raising the seedlings for say 2 or 3 years. At the

end of these 3 years, you can select those plants that will that have been showing a very fast rate of growth, and you can send those plants to the field.

So, all the plants that are finally, planted on the field will be showing a very fast rate of growth. So, it is possible to have a better and uniform crop growth in the field; because a better, because you have selected for those plants that are showing a faster growth rate and at the same time it is uniform. So, all of your plants will be growing at nearly the same rate because of which any silvicultural operation that needs to be done later on to the stand will become much easier to manage.

So, better and uniform crop growth in the field, due to selection of vigorous and healthy seedlings. So, those seedlings that are showing fast growth, and those seedlings that are completely healthy; only those are selected to be sent out to the field. Next, off season sowing of seeds is possible. Now, what happens in nature is that, a number of seeds germinate in the rainy season; but then, rainy season is also the best season for the establishment of a seedling.

So, if you have a seed, or if you if you if you want to raise plants out in the field, it is much better to begin a bit before the rainy season. Now, in a nursery, you can artificially irrigate the seedlings; we can artificially make them germinate by manipulating the conditions in the nursery. Once your seedlings have germinated, you can grow them. So, because you can manipulate the growing conditions; so, it is immaterial which season you are doing the plantations or which season you are raising the seedlings.

So, you can begin in say the spring season, or you can begin even earlier in the winter season. And, you can ensure that, by the time the rainy seasons come, your plants are already a bit big in size; so, they are like this big. So, that when you put them out in the field, they have a competitive advantage. So, so this off season growing of seeds sowing of seeds is possible, in the case of nursery. But it is very difficult out in the field, because you have little control over the growing conditions.

Now, lower seed requirement of nursery raised crops due to better management. So, because of better management; because you are able to provide better protection, you are able to provide the management interventions. So, a large number of seeds are germinating and they also are able to survive as seedlings. So, if the mortality goes down, the seed requirement also goes down. As we have seen earlier, the total number of

seeds depends on the on the number of plants that you want to plant. But it is also dependent on what is the rate of germination? what is the rate of mortality? what is the loss factor in pricking out and so on.

Now, in the case of a nursery, you have much better control over germination mortality and so on, because of which the seed requirement typically is lower. And, easy management of insects, pests, diseases and weeds, because these plants are growing close together. So, it is very easy to apply insecticide, pesticide, weedicide onto your young seedlings.

So, we can see that nurseries have a very important role to play in the silvicultural operations. Now, the next question is where do you plan a nursery? what are the locations? where your nursery should be located?

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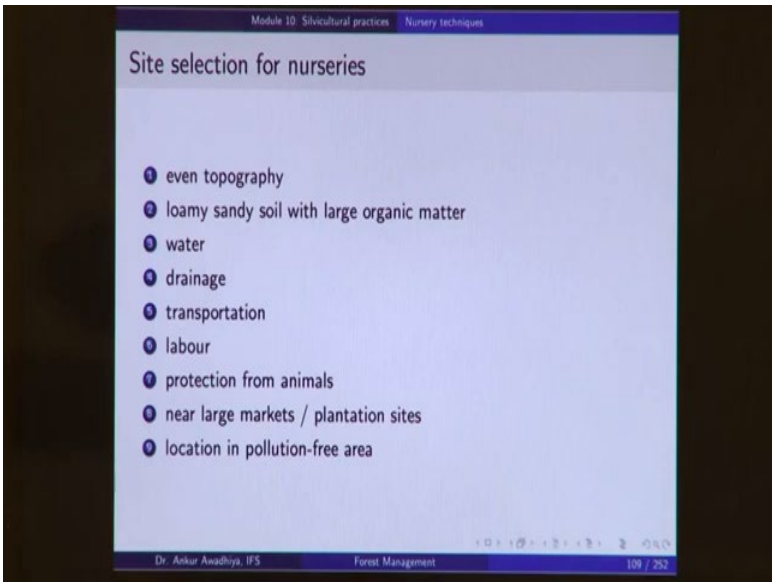

So, there are certain siting factors that help us to select the location for setting up a nursery. The first is even topography, because your nursery will be a very small place; but, if it is a flat land, then the management will be much easier.

Because your staff will be able to traverse easily. And, also because irrigating of this area will become easier, if the topography is even. Typically, we prefer sites with loamy sandy soil with large organic matter; because, a loamy sandy soil, is perhaps the best soil for the growth of plants; for the growth of a majority of plants. And, if you have this soil

then this soil can very easily be used, in the making of the growing beds or as a potting medium.

So, loamy sandy soil with large organic matter is preferred. There should be good availability of water in the site, because you will have to irrigate the seedlings. There has to be a good amount of drainage, so that there is no water logging that will inhibit the growth of seedlings. There should be an ease of transportation. So, typically, we locate our nurseries near to the roads. So, that once the plants have been cultivated in this area, it is easy to transport them out into the field.

Easy availability of labour, because nursery management is a very labour-intensive job and you would require a number of manual operations to be done, whether it is pricking out the seedlings, transplanting them, filling up the polythene bags, and so on. So, there should be an easy availability and perhaps also a cheap availability of labour. Protection from animals because these seedlings are also very good food for animals.

So, typically, you will find that the herbivorous will try to enter inside because of which you need to have good amount of protection; perhaps, by means of fencing or by means of walls. Pear large markets or plantation sites, so that ultimate transportation costs go down. And, also located in a pollution free area; because, in the case of very polluted areas, you have large amount of settlement on top of leaves, which also reduces the photosynthetic ability of the plants. So, typically, we want to have a nurseries in areas that are pollution free.

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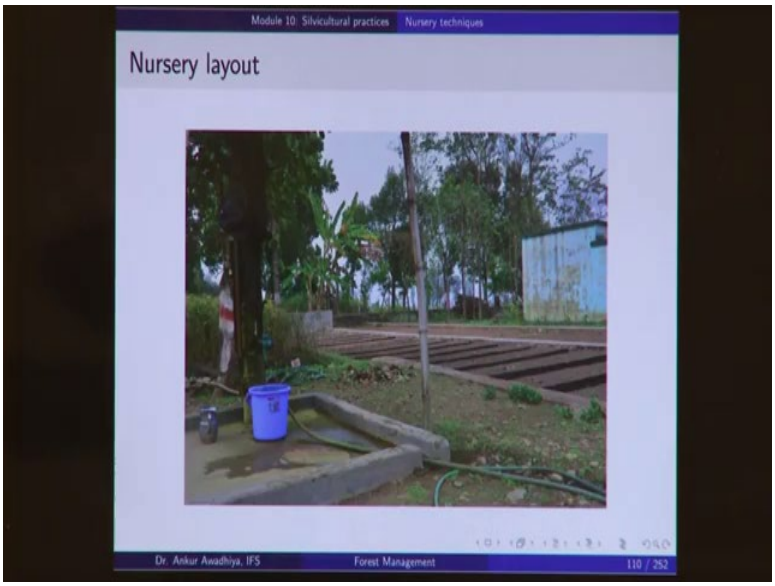

Next, how do you lay out a nursery? A nursery needs to have several things. So, there will be certain areas where you will be raising your beds.

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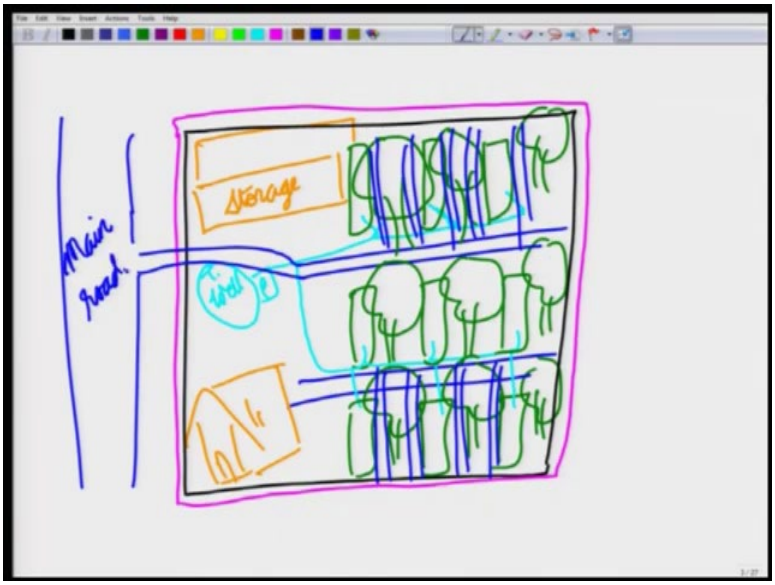

Let us say that this is a nursery. So, there will be certain areas, where you will be raising the beds. So, this is where the plants are actually grown. Now, these beds should also be accompanied by trees to provide certain amount of shade to the beds, so that these are not completely exposed to the sun.

Then, in the nursery, you will require these roads, so that people are able to access the beds, for the different op management operations that will be required. Now, at the same time, you will probably require a source of water. So, probably there is a well or a tube well, with a pump set, which is providing water; perhaps, through pipelines.

Now, because you need to have a chowkidar (guard) to protect this area. So, you will also require a chowkidar (guard) hut in this area. Then, they will also be a unit for storage; so, because we need to store the seeds; you need to store fertilizers manures, and so on. Plus, all of this area will have to be fenced, for protection. And, also you will have connection to the main road, for transportation. So, this is a typical layout.

So, here, in this picture, we can see that here we have the beds here. We have a tube well that is providing water for irrigation here. We are saying that there is a storage room; we see a plenty of trees in this area to provide shade to the bed. So, there will be some beds that will be having a larger amount of shade; there will be some beds that will be more exposed.

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Now, fencing is very crucial for a nursery. So, if you did not have a fencing here, then the animals will be able to get inside.

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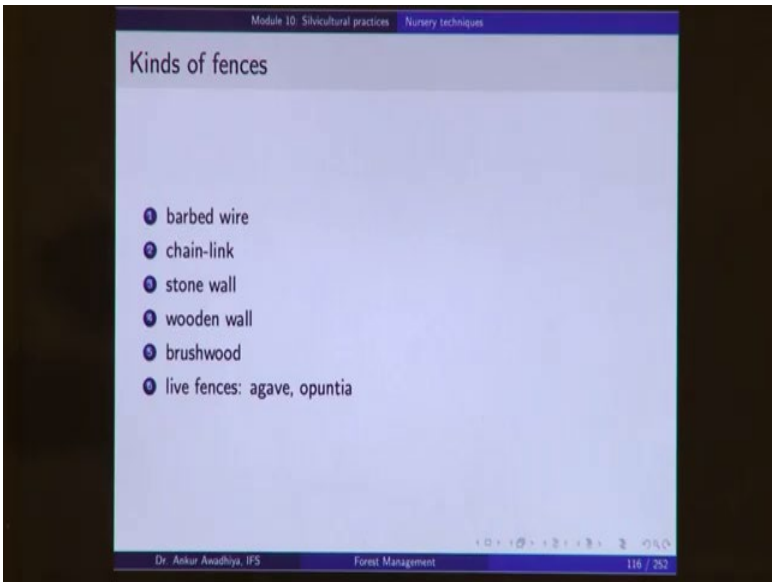

So, here, we can see the fencing poles and there is barbed wire that is moving around. Now, fencing can be of different kinds. We mostly use barbed wire fencing because it is cheap, but we can also go with a chain link fence, or a stone wall, or a wooden wall, or a brushwood fence. Now, a brushwood fence is also known as a barbed fence. And, in the case of a brushwood fence, people take brushwood. Now, brushwood is branches and twigs of different plants preferably those plants that are a bit thorny, and they can be made into a fence. So, that is a brushwood fence.

Or, we can even go with live fences like agave and opuntia. So, these are those plants that have thorns or spines, and these plants can be raised along the boundary of the nursery to act as a fence. So, these will be known as live fences or green fences.

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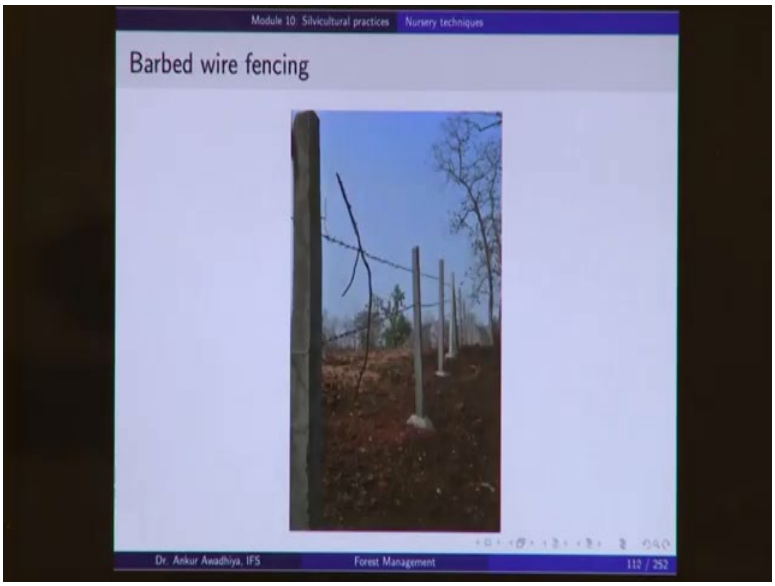

So, this is a typical barbed wire fencing, here we are seeing these cement poles. So, these cement poles are reinforced poles, and they are put in into the ground by digging a hole and putting the fence putting the pole, and then also putting concrete around it for setting it up. And then, there are certain projections on these poles on which the barbed wire fence is laid.

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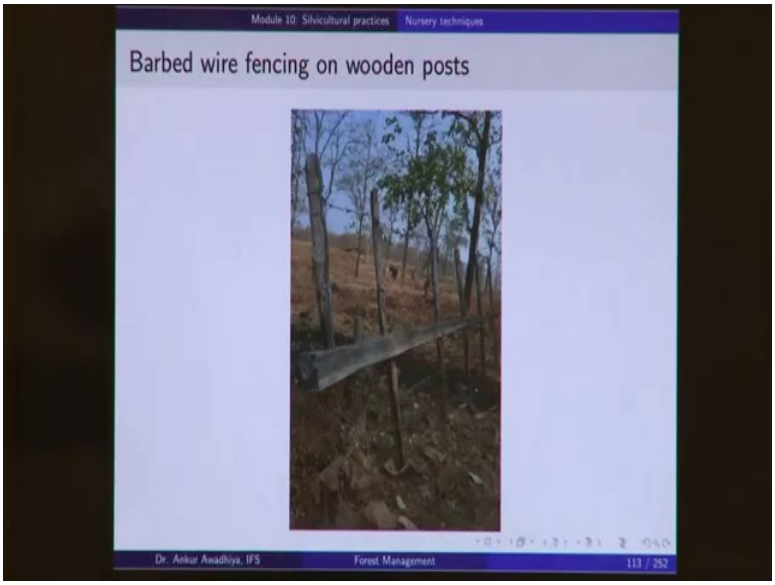

Now, along with the concrete poles, we can even make use of wooden posts. So, this is a fencing with wooden posts. So, we have wooden posts and we have these barbed wires.

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This is a typical brushwood fencing. So, these are just some twigs and branches that have been fashioned into a fence this is a stonewall fencing.

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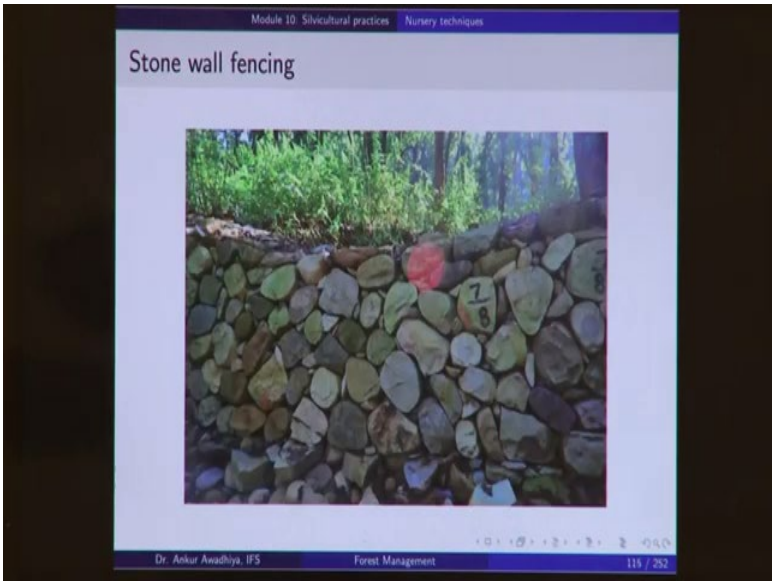

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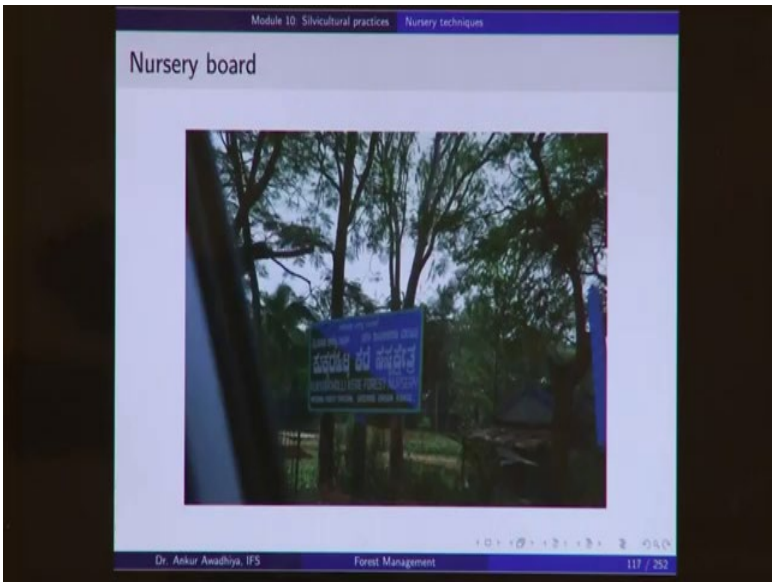

Now, typically you will also have boards for information to public, because a nursery also serves as a point where people can purchase or procure these plants. So, if somebody wants to raise certain species, on their fields; on in their homes, they can purchase the plants from a nursery, including a forest nursery. Now, the nurseries can be raised by the department, or in certain cases, we outsource them to the joint forest management committees.

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Now, we will have a look at this joint forest management in a later lecture. But, we can also have nurseries that are being managed that are being built and maintained and managed by the joint forest management committees, mostly in collaboration with the forest department.

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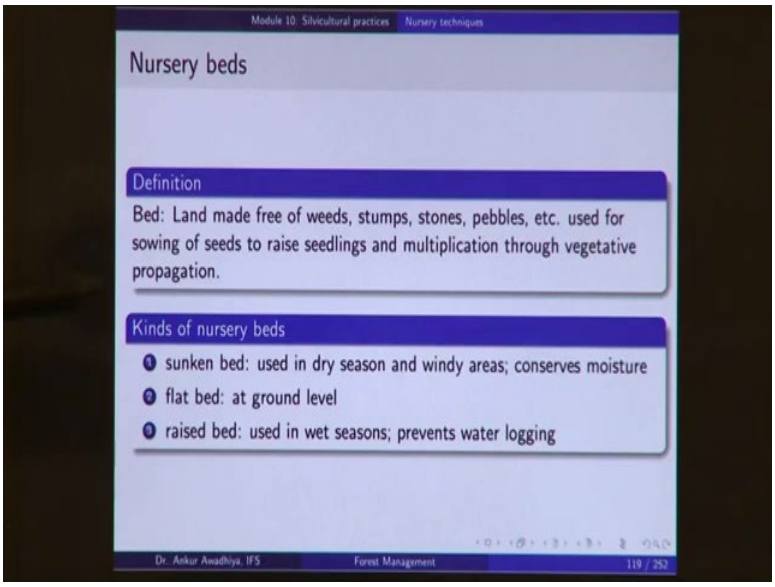

Now, in these nurseries, we make beds. Now, what is a bed? A bed is defined as, "a land made free of weeds, stumps, stones, pebbles etc., used for sowing of seeds to raise seedlings and multiplication through vegetative propagation."

So, what we are saying here is that, a land will be having a number of inert materials a number of which will not be useful, or may even be detrimental to the growth of seedlings. Now, if you prepare your land in such a manner, that you have removed all these detriments, such as pebbles stones stumps and so on. Then, this prepared land is known as a bed. And, there are three different kinds of beds. We can have a sunken bed, a flat bed or a raised bed. So, what we are saying here is that.

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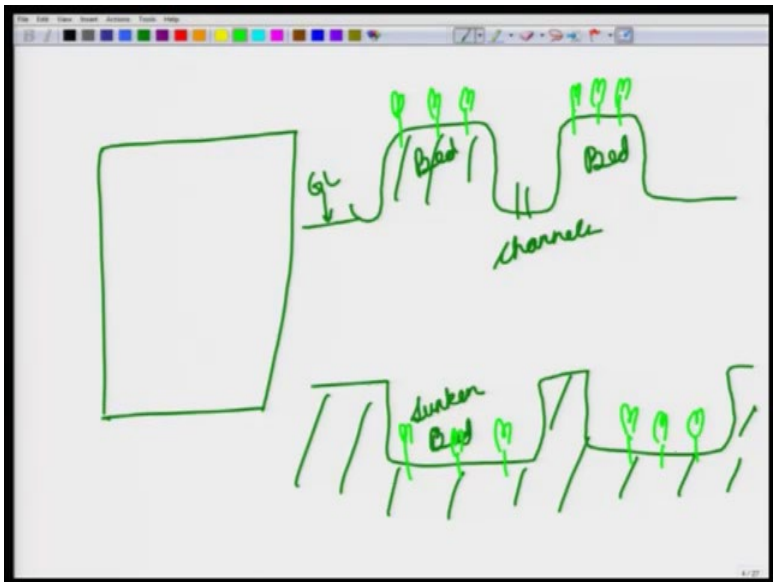

If you take a piece of land, and you have removed all the pebbles stones stumps and so on. And, you have prepared this land, to raise your seedlings, then this will be called a bed. Now, you can have a flat bed or you can have beds. So, if you look at them from the side, you can have a bed like this. So, this is the ground level. So, you can have a bed that is a raised bed. And here, you have channels, or you can have a bed that is a sunken bed.

So, this is a sunken bed. And now, in the case of a raised bed, you will be raising plants above the ground level. In the case of a sunken bed, you will be raising plants below the ground level.

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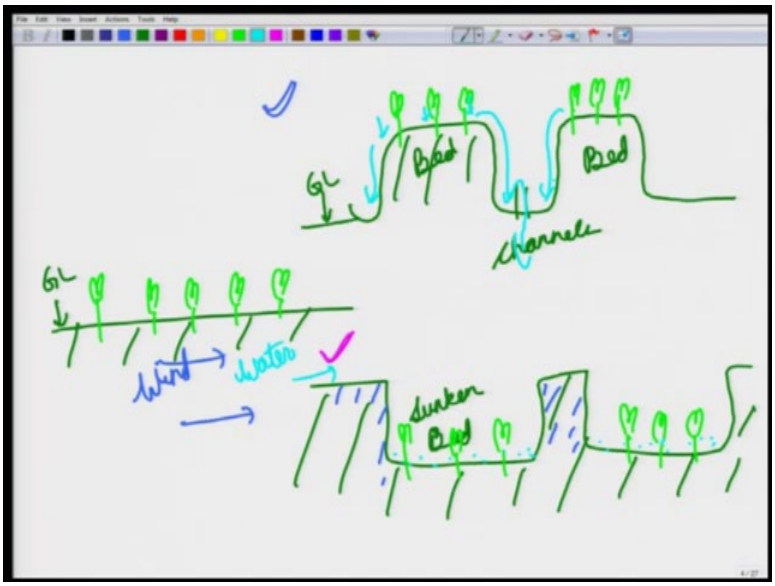

And, in the case of a flat bed, you will be raising your plants on the ground level. Now, when do when should we use which kind of a bed? A sunken bed is typically used in dry season and in windy areas, because it conserves moisture.

So, in the case of this sunken bed, if you add water to this area, the water will enter into these beds and it will stay in these beds for a longer period of time. So, the water gets concentrated in these beds. So, we prefer them in the dry seasons or in windy areas, because if we look at the impact of wind, then these structures will protect the plants from the impacts of high winds, especially the desiccating impact of the winds. So, we prefer sunken beds, in dry seasons and in windy areas.

Flat beds are made at the ground level. Raised bed is used in wet seasons, because it prevents water logging. Because what happens in the case of a raised bed is that, the water is not able to accumulate on the top. So, any water that accumulates goes down and then moves away in this channel. So, water logging of plants is avoided. So, typically in the rainy seasons, we go with raised beds. And, a flat bed is used when the season is neither very dry not as very wet. So, that is the average sort of a condition. So, we have these three different kinds of beds.

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So, this is how these beds look like. Now, this one is a raised bed. So, we are growing plants in this area and these are the channels.

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When the plants grow, it looks like this. So, here we can see that these beds are raised up from the ground level and the plants are being rolled on top of these beds.

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Sunken beds look like this. So, here is the ground level and, we have made a depression, and in this depression, we are raising up these plants.

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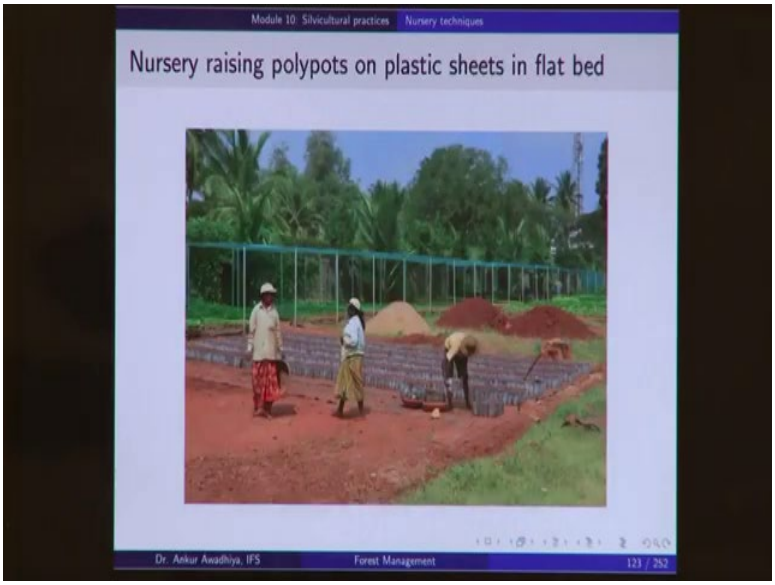

And, a flat bed is like this. So, here on the ground level itself, grass has been removed and we are raising the plants in poly pots, in this flat bed. Now, in a number of situations, when we are growing plants in polythene bags, we also add a plastic sheet beneath these poly bags; so, which is a very thick sheet. So, we can see it here. So, this plastic sheet prevents the growth of roots, if they are able to move out of the polythene bag.

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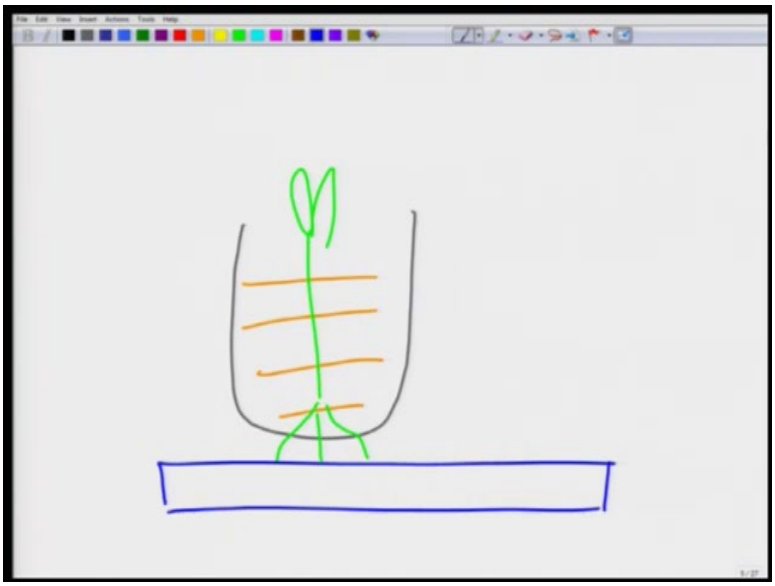

So, essentially what we are saying here is that in the case of a polythene bag. So, we have soil here; we are raising a plant here, but in certain situations, the roots of the plant are able to penetrate the polythene bag. And, if these roots are able to reach into the ground, then the plant will start to establish itself out here in the nursery. Now, a nursery is not meant to for the seedling to establish itself. A nursery is meant so that the seedling can later on be transported to the field and planted there.

So, to prevent its establishment what we do is that we add a thick sheet of polythene below this polythene bag. So, that the roots are unable to reach the ground. Now, with we when we are making these beds, we need to treat the soil.

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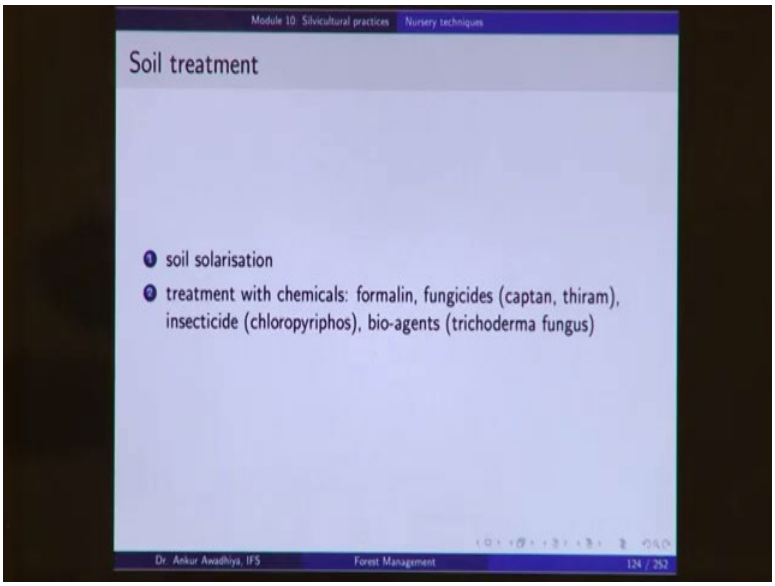

Now, treatment is typically two kinds of treatments are done. The first one is soil solarisation; what is solarisation? You take the soil, break it into small parts; break up the lumps, and spread it out in the sun. So, that the sun is able to dry up the soil, and also the ultraviolet light is able to reduce or eliminate the pathogen load in the soil; so that is soil solarisation. So, we typically do it before we are making the beds.

The second treatment is treatment with chemicals, including formaldehyde, fungicides such as captan and thiram, insecticides like chloropyriphos and bio-agents such as Trichoderma fungus. So, formalin kills possibly all forms of life that are there. So, essentially if you have a soil that is having a very high pathogen load, you will typically treat it with formaldehyde. Or, if your soil is having pathogenic fungi, you will treat it with fungicides.

If you have insects or pests, then you will treat it with insecticides and bio-agents, such as Trichoderma fungus are added to the soil, because it acts as a same biotic fungus which helps in the growth of the plants. So, different kinds of treatments are given to the soil.

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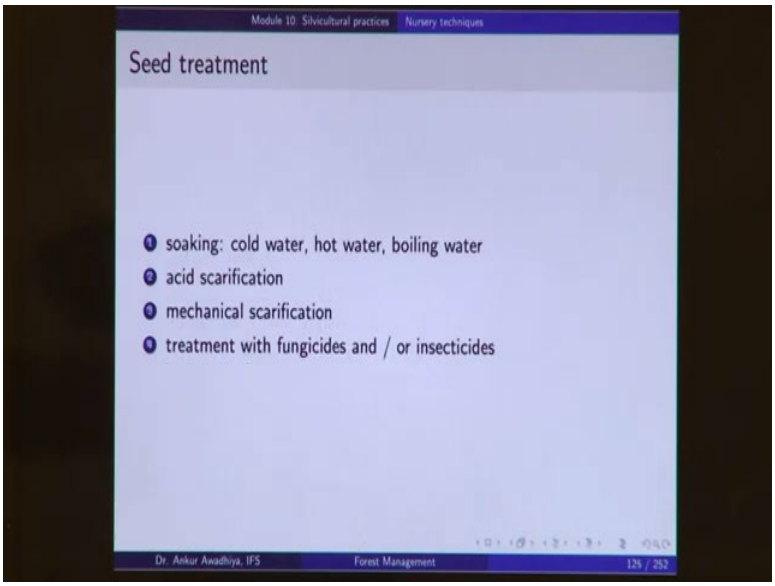

And, as we have seen before sowing, the seed is also given certain treatments. Typically, soaking either in cold water hot water or boiling water, or in certain cases acid or mechanicals scarification, or treatment with fungicides and/or insecticides, may also be required before the sowing operation.

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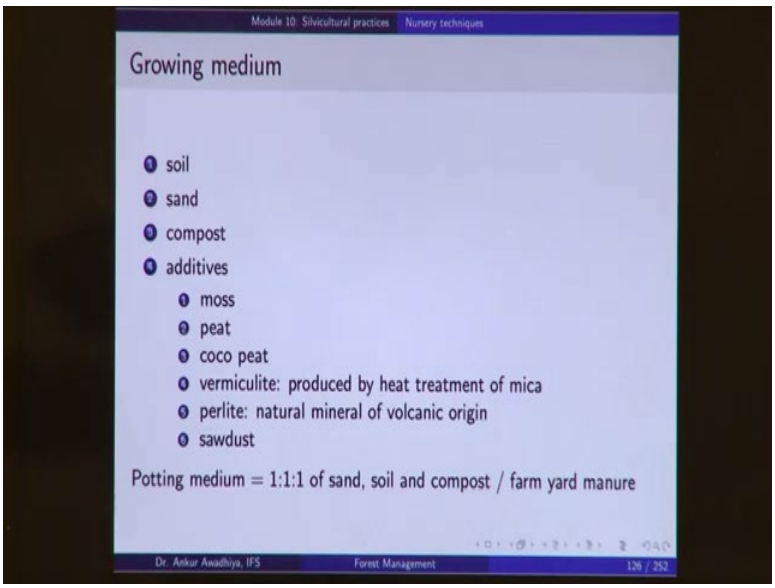

Now, once your seeds are ready; once your beds are ready, you need to ensure that you have proper growing medium for the plants. Now, we have two different kinds of media.

One is the germination medium and the second one is the growing medium. Now, a germination medium, typically is just plain sand. So, you can raise a bed.

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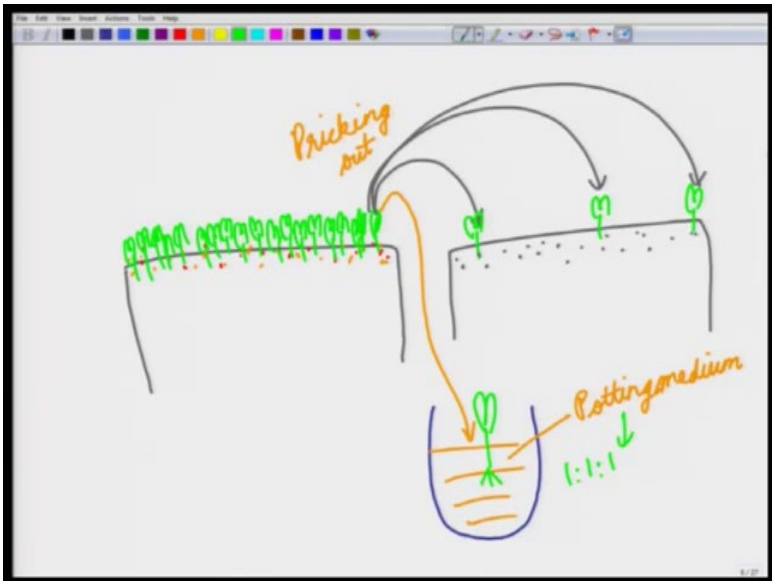

So, let us say that this is a raised bed and on top of it you can add sand, on which you will add the seeds; irrigate it, and you have the plants that are growing here.

Now, once these plants have germinated, because they will germinate in a very high density. So, next will have to reduce the density. And, this reduce this reduction of density is done through a process that is known as pricking out. Now, what is pricking out? In the process of pricking out, you will take these plants and move them into another bed, while maintaining the proper density. So, we are removing these plants from the germination bed, and we are shifting it to the growing bed.

Now, in this growing bed, we will need to put the growing media. So, this is not just sand, this is a growing medium. Now, growing medium comprises of a combination of soil, sand, compost and additives. Now, soil is important for the growth of plants, sand is added to make the soil more porous. So, addition of sand will ensure that there is no water logging, and the plants are rebuilt, and the roots of the plants are able to get access to the air.

Compost is added not only to fertilize the soil, but also to ameliorate this structure of the soil. So, organic matter is added. And, also we can add certain other additives such as

moss. Now, moss matter; moss is also added to change the structure of the soil or we can add peat. Now, a peat soil is a soil with a high organic content. So, here again, when we are adding peat, we are increasing the organic content of the growing medium. Or, we can add coco-peat which is in which is a replacement for peat for those areas where we do not have access to peat.

So, it is made out of coconut shells or we can add vermiculite. Vermiculite is a substance that is produced by heat treatment of mica. And, this substance is able to helped the help thus the soil, retain moisture and it also changes the structure of the soil. Or, we can add perlite, which is a natural mineral of volcanic origin. It is very similar to sand, or we can add sawdust. So, we can add all these different additives, depending on whether we need to change the structure of the soil.

So, these are the growing medium. Now, later on, if we want to shift these plants into polythene bags, then we can also make use of the growing of the potting medium. The potting medium is something that is used in pots. So, what we are talking about here is that, if we have a polythene bag, and this polythene bag will also have to have certain soil. So, this soil is the potting medium.

So, in this case, we are shifting one plant and we are planting it in this polythene bag. Now, this potting medium typically is the 1:1:1 ratio of sand soil and compost or farm yard manure. So, this is a typical combination 1 : 1 : 1 sand soil and compost or farm yard manure, which is used to raise these seedlings in polythene bags or in pots.

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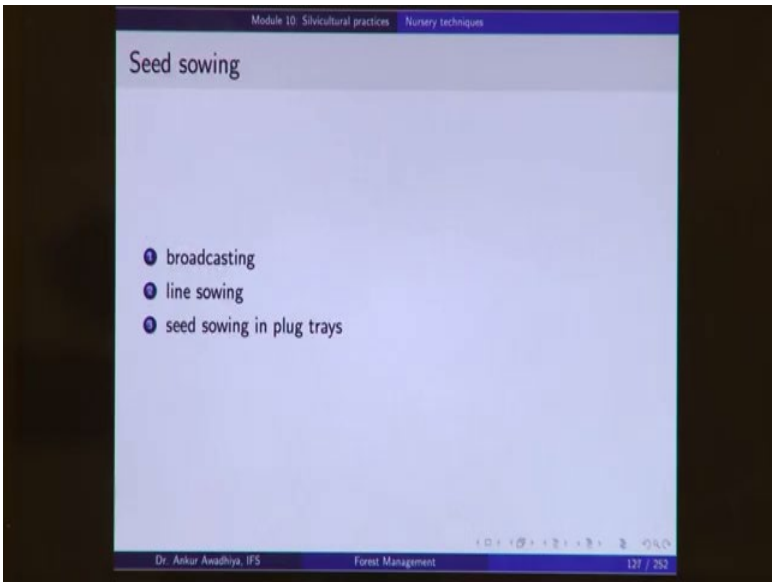

Now, the sowing of seeds can be done by various ways. One way is broadcasting. Now, in the case of broadcasting, you just take the seeds in your hand and you just throw them out in into the bed. So, when you throw the seeds, this is known as broadcasting. Another method is that of line sowing. In the case of line sowing, what we do is.

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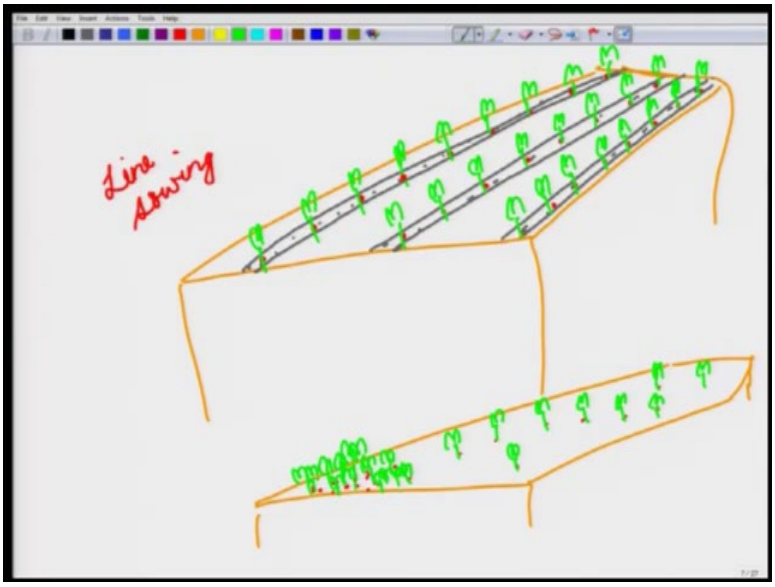

If this is a bed, then we will create grooves in this bed. So, here we are making these grooves in the soil and then, they will add a seed at every certain distance in this groove. And then, we cover these grooves with soil or the growing medium.

Now, in this case, the plants that come up will come up at finite distances. And, in this case, the density or the spacement of the plants is easily controlled. Now, this is line sowing. Whereas, in the case of broadcasting, if we consider this bed; in the case of broadcasting, it is possible that you have a greater concentration of seeds here and a lesser concentration of seeds elsewhere.

So, in this case, when the plants come up when they germinate, and you will have a very high density here, because of which your plants will not be able to grow properly. Whereas, you will have very less density in the other areas, in which case, we can say that we are not fully utilizing the bed. So, line sowing is able to overcome this issue.

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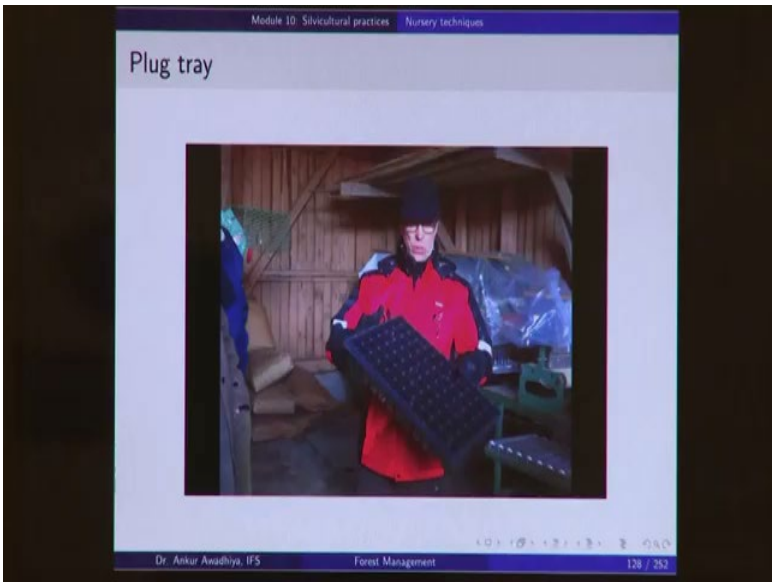

Now, another way is to raise the plants in plug trays. Now, what is a plug tray? This is a plug tray. So, here you have a tree that is made out of plastic; it has a number of small plugs or containers in which the plants can be raised. So, what we do is, if you have these plugs.

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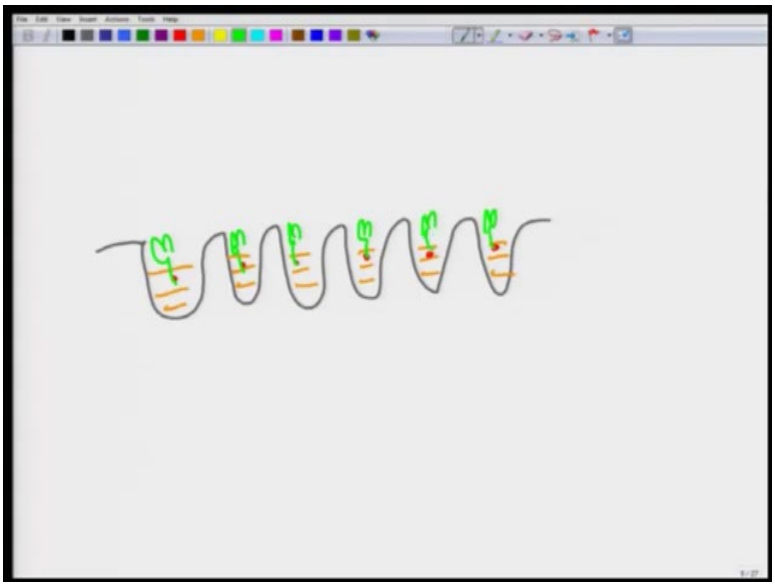

So, we will add potting medium to them, and then in every plug, we will be adding a seed and so, we will have one plant in every plug. Now, the good thing about these plug trays is that because they are made of these standardized sizes. So, we can have machines that can put seeds into these plugs; otherwise the option that is available is to do it manually.

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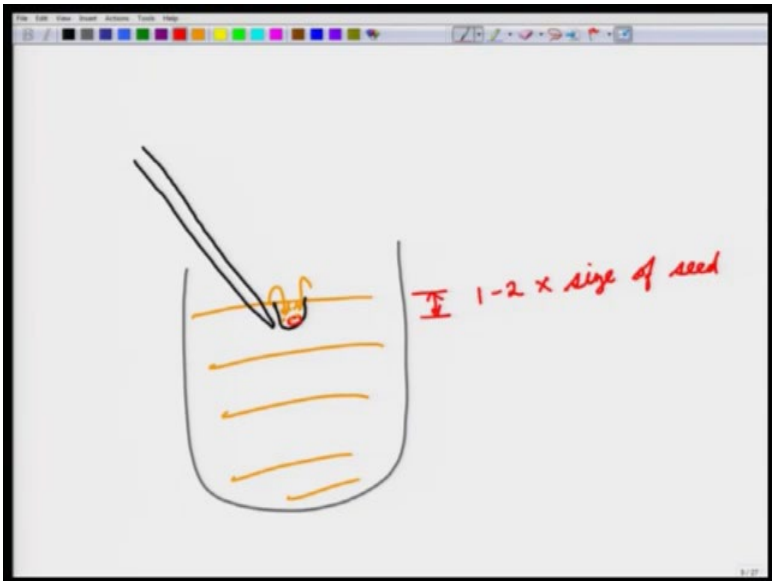

In the case of a manual operation, the worker uses a sharp object to take out some soil and create a hole. In this hole, a seed is put and then, the surrounding soil is added to it. And, in this way, we are able to put a seed into one of these pots on in a polythene bag.

Now, the important thing to keep in mind here is that the depth of the seed should be roughly one to two times the size of the seed. So, essentially your seed should be near to the surface, but it should not be exposed to the surface. And, it should not also be so down, below that the plant, when it is germinating it is not able to come out.

So, roughly the depth is one to two times that of the seed size. And, in the case of a plug tray, the machine can be set so, that it always adds these seeds at this particular depth. So, this not only reduces the requirement of labour, but it also ensures maintenance of quality.

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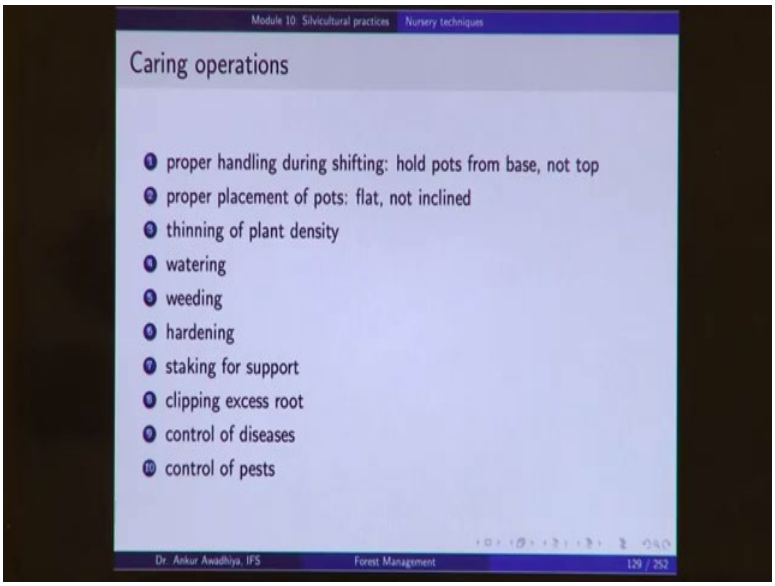

Now, once you have raised your plants, next you need to care for these plants.

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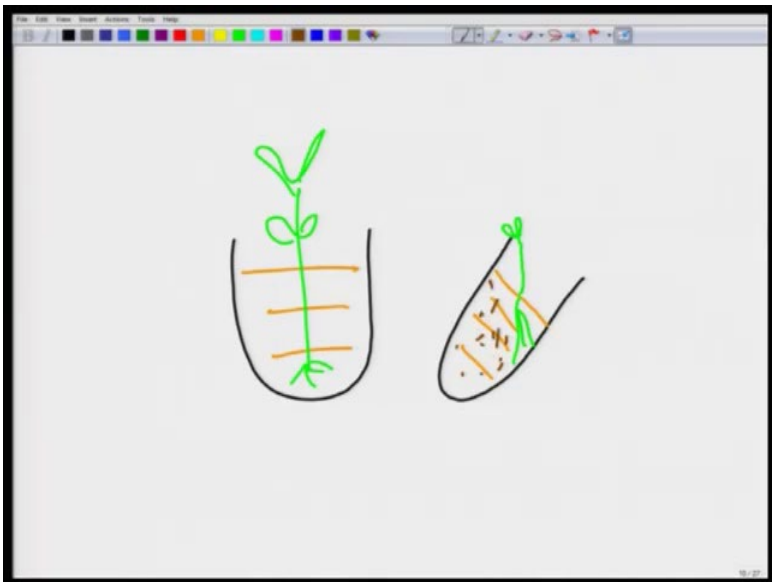

Now, what is the sort of care that we require in a nursery?

One proper handling during shifting; hold the pots from the base and not from the top.

Now, when people need to move these polythene bags, So, here you have a bag with soil and with a plant. When you when you need to move this polythene bag from one place to another, you should hold it like this.

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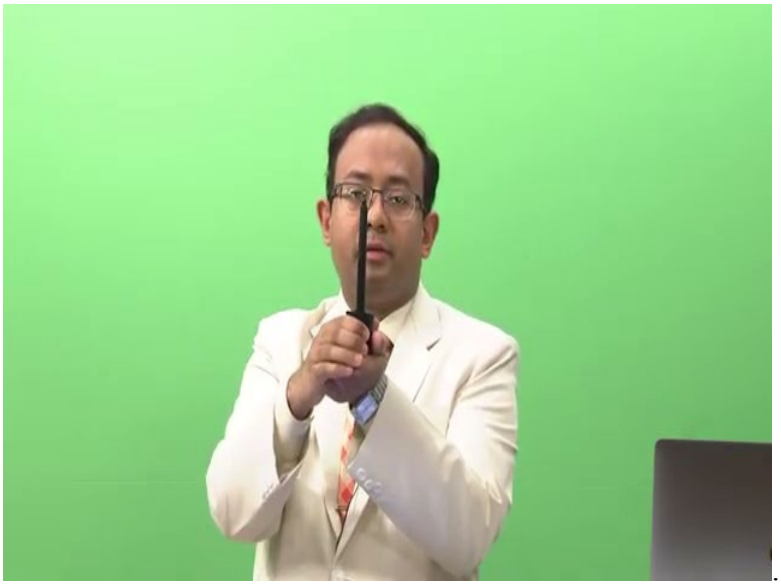

Suppose, this is the plant; you should not hold it from the plant, you should hold it from the base. So, that the plant is not damaged. To proper placement of the pots, it they should be placed in a flat position and not in an inclined position.

Now, this is because the roots are positively geotropic; what do we mean by positively geotropic? They go towards they go in the direction of gravity. Now, suppose you kept a pot like this, in this case, what will happen is that, your plant will start to grow like this and the root will grow like this. Now, later on, when you want to put this plant in the field, you will have a plant that is growing like this, which is neither good for a field situation. and, at the same time, the roots are not able to get access to all of this soil.

So, whenever you are using these plants, they should be raised in an upper right position straight up. Next caring is thinning of the plant density. If you are growing plants that are very close together, then one there will be a dearth of resources; there will be out competing each other, and to there will be a phenomenon that is known as whipping. Now, what is whipping?

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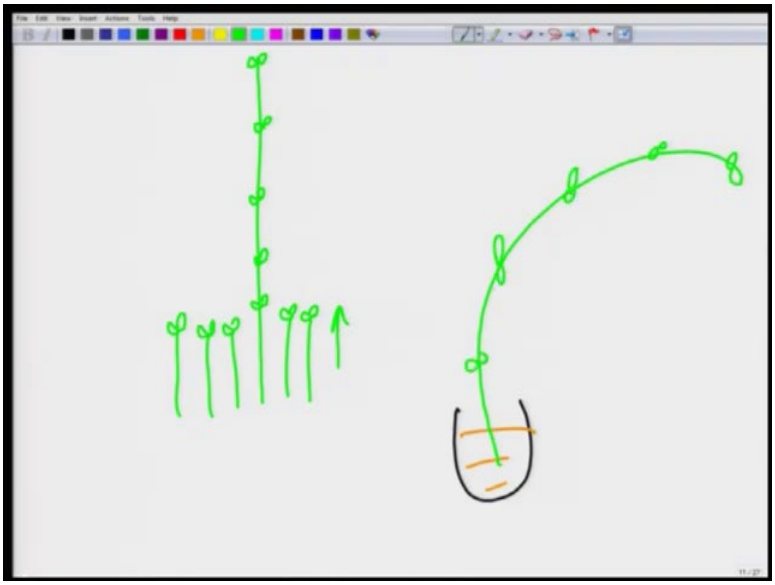

If you are having plants that are very close to each other, then because each of these plants wants to have access to light, it will try to grow up as soon as possible.

So, you will have these plants that grow very tall. Now, in these tall plants, they have not had enough time to put up their side words growth. So, they are only growing in one

direction putting all their energy in growing up. So, what happens, in this case, is that because the sideways tissues are not developed. So, once you take this plant out of this scenario, you will have a situation where you have this pot, and you have this plant that starts to whip. So, it is falling because of its own weight. Now, to avoid that you need to ensure that the plants are not raised in a very high-density environment; there is a thinning operation that is done from time to time.

Next, you need to water the plants you need to do weeding. You need to do hardening. Now, what is hardening? When you are growing these plants in the nursery scenario; so, there you are putting a great amount of care, you are giving a great amount of care to these plants. But then, when once you shift these plants out in the field in a forest area, then there is nobody to take care of them. So, if there is a sudden shift between say watering every day versus getting water only in the rainy season, and then, there is a good possibility that the plants might not be able to tolerate this certain shift. And, there will be a large-scale mortality. Now, to avoid that you need to harden the plants, and this hardening is done by gradually reducing the amount of water that is being provided to the plants, and also by exposing them slowly and slowly to more extreme conditions.

So, for instance, earlier if you were raising a plant in a shade net, then you will gradually tend to increase the amount of light that is available to the plant. And finally, you want to shift the plant to harsh sunlight. So, once this plant has remained in the harsh sunlight for a few days or say a few months, then it is now ready for the field situations, because in the field it will typically be getting a very harsh sunlight then staking for support.

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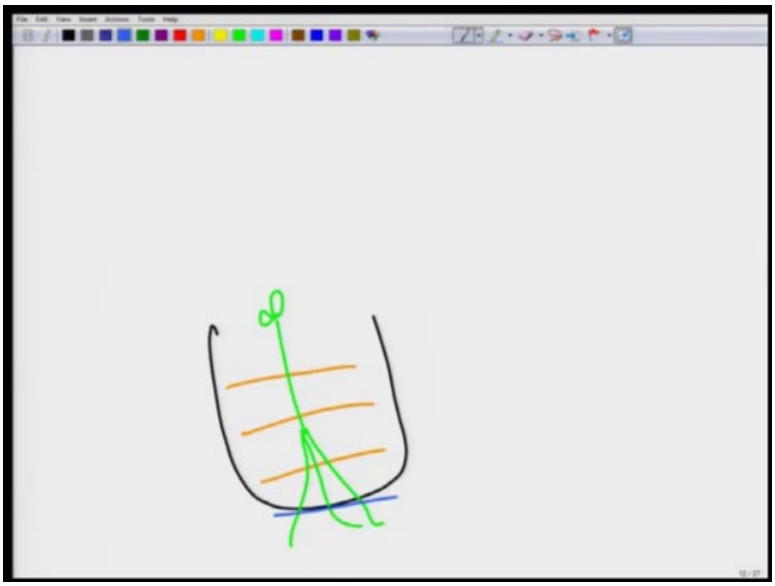

Now, what is staking? In the case of some plants, that are unable to raise themselves you might need to add a stake and tie the plant with the stake, so that this plant does not fall down. So, there will be a stake right next to the plant and the plant will be tied to it so, that this plant is not able to whip down. So, staking might be needed. Clipping of excess roots; so, in the case of a plant, suppose the roots have come out of the polythene bag, then they will need to be clipped, at this point. And, this clipping is also a caring operation to prevent the rotting of or the killing out of the roots on exposure to pure air to, when control of diseases and control of pests by the use of insecticides pesticides and so on.

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So, here we can see that in a nursery there is a large-scale operation and people are regularly caring for the plants regular watering of plants is done.

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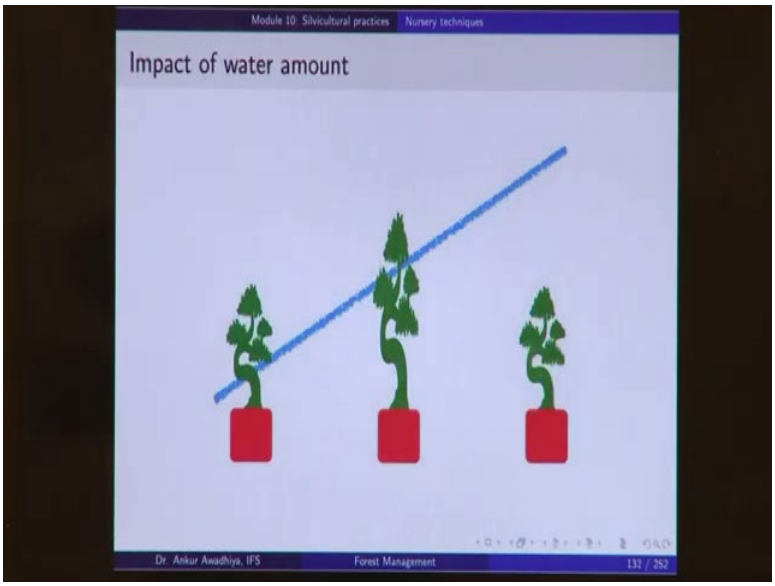

But then, this watering also has to be controlled. Because, if we look at the impact of different amounts of water to a plant; so, let us say that this curve is showing that different amounts of water are being provided to the plants. Now, this plant is only getting a small amount of water.

So, its growth is limited; this plant is getting more amount of water. So, it grows at a rate that is faster than that of the first plant. But then, in the case of this plant which is getting a very large amount of water, then there will be water logging. And, this water logging will then adversely impact the plant growth and the plant growth will come down. So, when we are doing watering of the plants, this watering has to be adequate. It should be neither very low nor very high.

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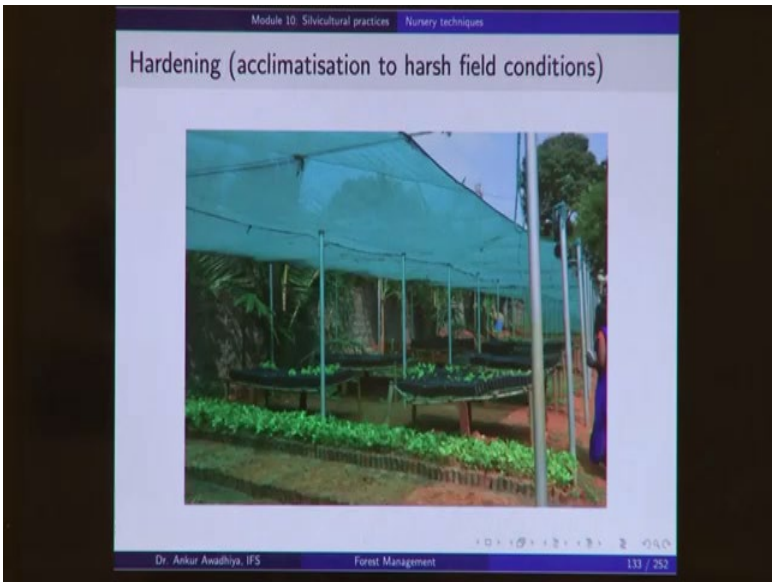

This is an image that is showing the hardening process. So, in this process, these plants are being raised under a shade net, so that they are not getting exposed to 100 percent sunlight.

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But they are getting exposed to say 70 percent sunlight. So, you will you will move slowly and steadily from 50 percent sunlight, 60, 70, 80, 90 and then finally, out in the 100 percent sunlight.

This is a weeding operation being done.

So, here you have these polythene bags so on, in which you have the plants and the grasses or other plants that are growing in these poly pots together with your plant of interest are being manually taken out. So, this is the weeding operation.

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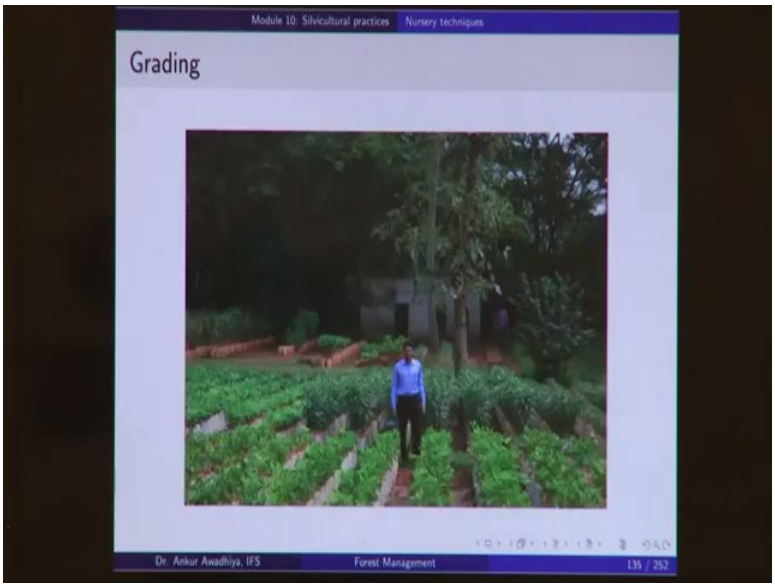

We also perform grading operation in the nurseries. And, in the grading operation, those plants that are of the same size that are showing the same growth characteristics they are kept together.

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So, they will be sent out as a lot. These are plants that are ready for sale or usage. And, here also we can see that there is these stakes that are there together with these plants.

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Then, transportation of these plants is done either by using a tractor and trolley or by using small trucks in which these plants are kept.

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So, in this case, we can see that these plants have been put in three different shelves. Now, these shelves need to be of at need to be at sufficient distances. So, that the plants are not damaged during the transportation.

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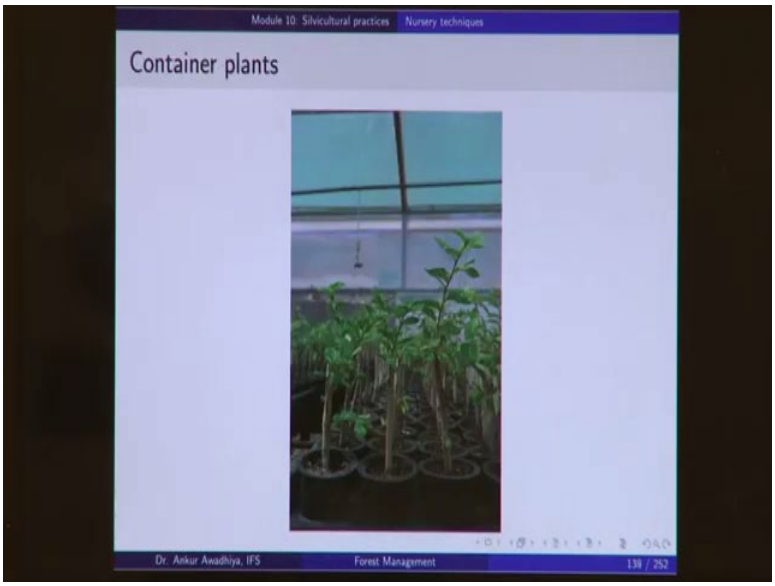

This is the raising of plants in containers. Now, container is a plastic pot like structure in all of these are of standardized sizes, standardized shapes. And, in this case, the mechanization of plant growth or plant production it becomes easier.

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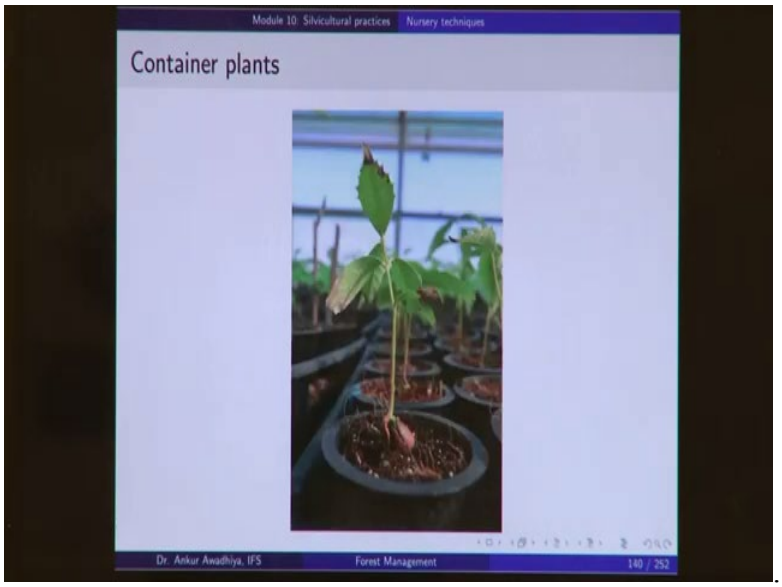

So, this is a plant that is growing in the container.

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Now, one innovation that has been done recently is that of the use of the raised iron beds. Now, in this case, what we are saying is that, you have these iron stands on which we are raising the plants; the use of a an iron stand, it is raising the plants. So, it is very similar to a raised bed, but then these plants are not in direct contact with the soil because of which the chances of the plants getting exposed to the pathogens reduces drastically.

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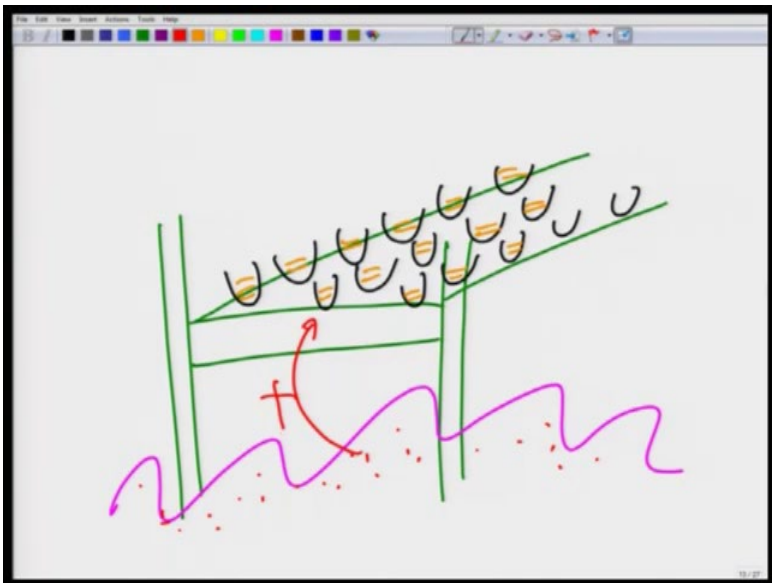

So, in this case, we are using these iron stands, and we are growing we are putting the poly pots on top of these. Now, these poly pots will be having the potting medium, and perhaps this potting medium is very different from the surrounding soil. So, probably the

soil here was not good enough for the plants. Now, here you have the potting medium, which is very different from that of the surrounding soil.

Now, the best thing is that, if you have pathogens here; if you have fungi or certain insects that are not able to move very far. So, these fungi or these pathogens will not be able to reach into these poly pots, because they are physically separated from the soil below. In the case of a raised bed, your plants were directly in contact with the surrounding soil. So, if there are pathogens in the surrounding soil, they will be able to reach the plants. But in the case of a raised iron bed, this possibility goes down substantially.

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Now, in certain nurseries, we also need to make use of greenhouses. Now, a greenhouse is a structure in which the climate gets controlled you have plastic or glass sheets that are able to capture the sunlight, and keep the inside much warmer than the surroundings. So, we typically use greenhouses in colder areas.

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These days in certain nurseries, we are also using mist chambers. Now, what is a mist chamber a mist chamber is a room in which the humidity is controlled to a level that is roughly equal to 100 percent.

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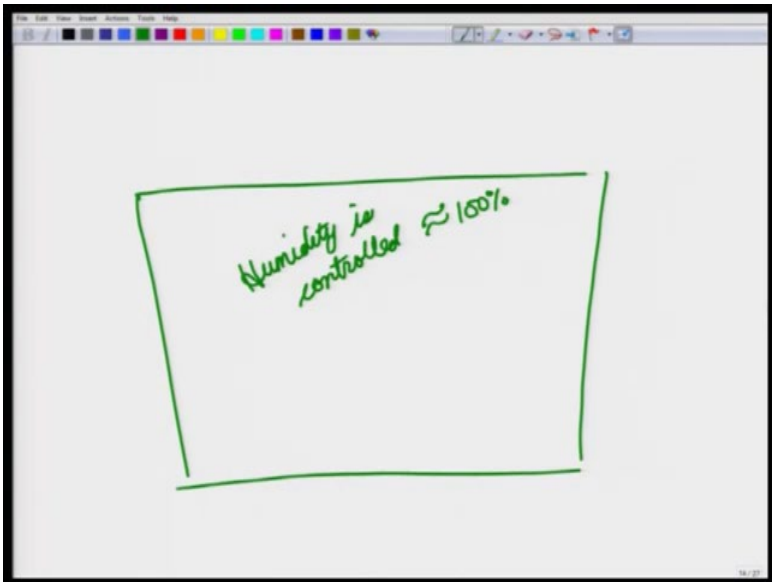

Now, what we are seeing here is that, we have these pipes on the top and from this these pipes, we will have a regular flow of mist because of which I and this room is covered from all sides. So, because of this mist the whole of this chamber will be kept at roughly

100 percent humidity. Now, why would you want to have an area with 100 percent humidity? Now, this is because in the case of certain plants that we are raising through vegetative propagation.

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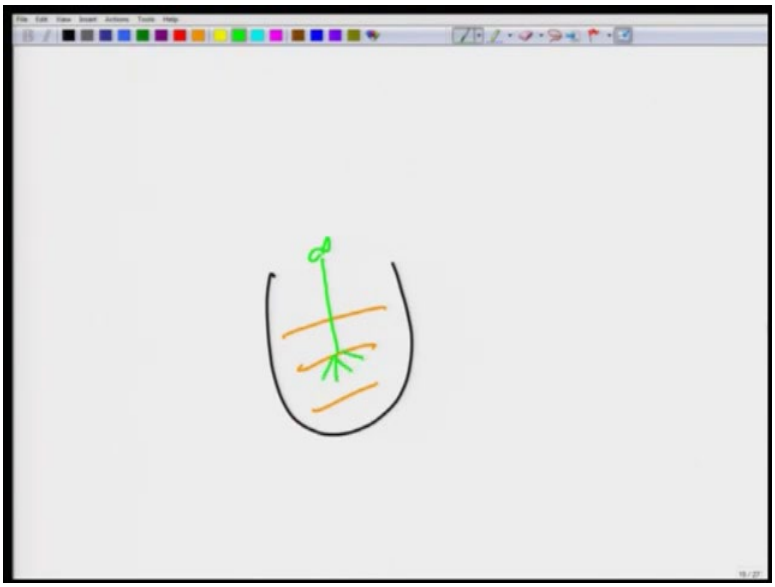

Then, in the case of vegetative propagation, you have taken a poly pot added the growing medium and you have just added a part of the stem. Now, this plant does not have roots, it does not have leaves. Now, this plant needs to be kept in a situation where it does not dry out, because it does not have roots. So, it will not be able to get water from the soil. But then, if the if the surrounding area is dry, then this stem will dry out in no time.

So, we keep such plants in a mist chamber where you have 100 percent humidity. So, that there is no loss of water, because of evaporation. And, we keep it till that time that it is able to develop the leaves and the roots.

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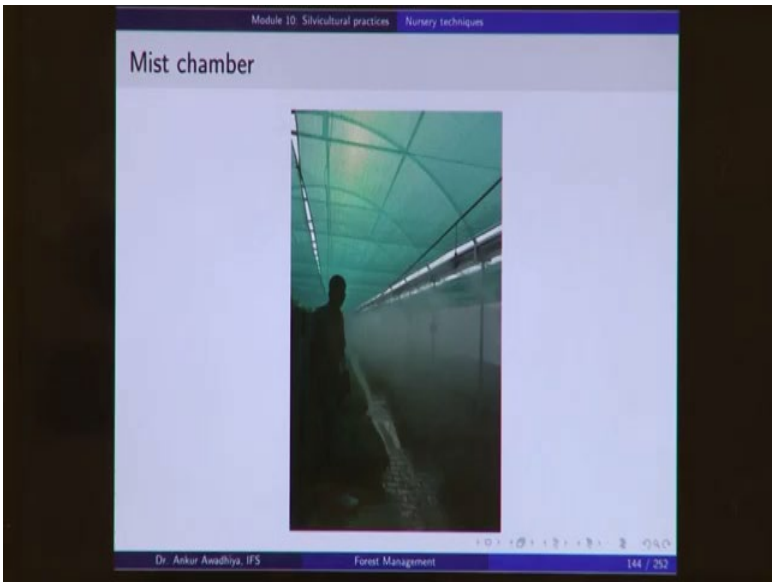

So, this is a mist chamber and this is how a mist chamber looks at looks while in operation. So, here we can see that there is a mist of water that is now, surrounding these plants because of which there will not be any loss of water, because of evaporation. In certain nurseries, these days we are also using tissue culture.

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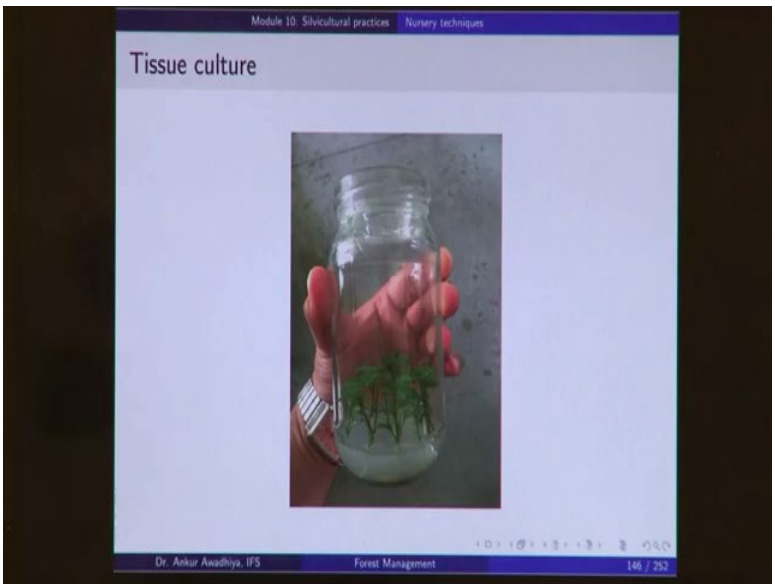

Now, in the case of tissue culture, the parenchymal tissues of certain plants are raised inside bottles in growing media. Typically, this growing medium also contains agar, so

that you have a solid medium on which to grow the plants. And, with the help of tissue culture, it is possible to do this vegetative propagation at a much faster rate.

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Another way of vegetative propagation is through cuttings. Now, here we are seeing a nursery in Punjab that is making eucalyptus through cuttings. So, in this case, the stems are cut, then they are then they are treated with certain hormones like rooting hormones which will aid in the growth of the roots. And finally, we will be able to generate a large number of eucalyptus plants through vegetative propagation.

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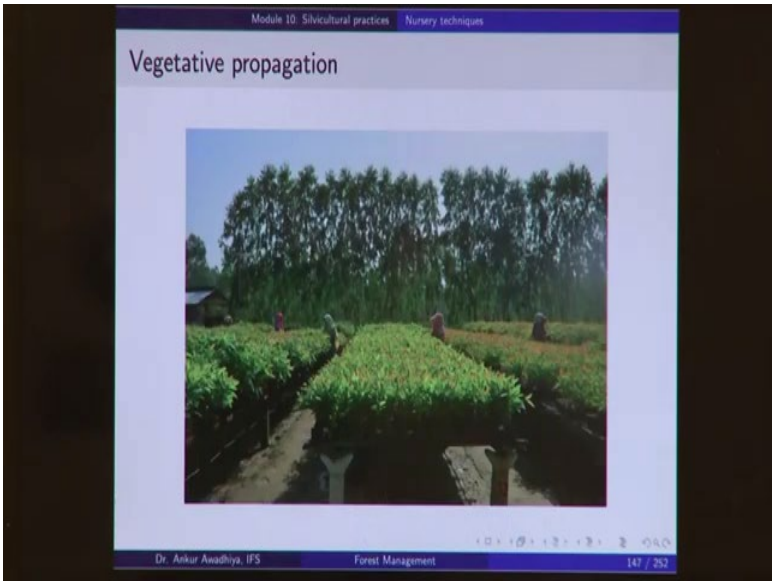

So, in this lecture, we started with what is a nursery? why do we need a nursery? what is the layout of a nursery? what are the things that we need in a nursery? and then what are the kinds of operations that we do in a nursery? Now, these nurseries can be low-tech nurseries, or they can be high-tech nurseries. The high-tech nurseries are those in which we are using tissue culture and mist chambers and vegetative propagation. And, we looked at different kinds of beds; we looked at different kinds of operations. You will get the impacts of watering and so on. So, that is all for today.

Thank you for your attention [FL].