Natural Resources Management (NRM)
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Week - 06
Lecture - 39
Precision farming and protected cultivations
And Simulations applications in Agriculture for NRM
Part – 2

So, continuing with precision farming, protected cultivation and simulation application in agriculture for NRM.

We will be now discussing about various type of practices that are required for better crop production, crop management and which are done in a very precise manner for utilization of less resources with large impact. Means, efficiency of the system will be enhanced by this kind of simple technology under precision farming.

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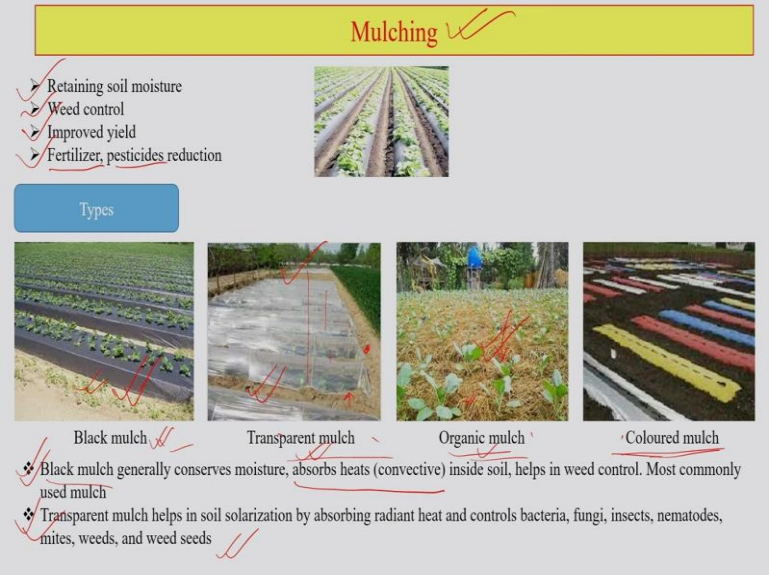

Now, one to mention is mulching; most of you might be knowing various kinds of mulching is done for agricultural crop productions, like you can have black mulch with black colored plastic, you can have transparent mulch with transparent plastic, organic mulching where you put different crop residue and then you can have colored mulching for different purposes, but certainly each one of them has different purpose and also different kind of investment.

Now, why we do mulching? Mulching, we largely do for retaining the soil moisture in the soil. So, when you do this kind of covering of soil, it actually reduces the evapotranspiration from the soil under the sunlight. So, the moisture in the soil remains into it.

It also helps in weed control, we know that weed is unwanted, so, anything, any plant which are unwanted within a cropping system, we call them weed. So, controlling weed is also another aspect of mulching. Certainly proper mulching will improve your crop yield and then application of fertilizer pesticides can be reduced by utilizing mulching in a proper manner.

Just now, I talked about different kind of mulching which are available and some of them are used largely in the developed country and many of them are also used in developing country. Now, black mulch as this particular picture shows; black mulch generally conserves moisture. Greenhouse if it is covered with the black thing definitely black will observe your heat inside the soils; it helps in weed control and this is one that you will see in many parts of our country.

Now, the transparent mulch that you see in these pictures, it helps in soil solarizations. Means if you need more sunlight for your soil, then you go for this kind of transparent mulching and they help in absorbing the radiating heat and controls bacteria, fungi, insects, nematodes, by sheer heat treatment, mites, weeds and all those kinds of things.

Organic mulching is useful from another point of view. In India as that there are various states which produce a huge amount of crops and after the harvesting it becomes an issue that where actually they will throw this crop refuse after taking the harvest what remains. Even to roll back into the soil, they required manpower and for them to put manpower for just managing those crop refuse may seem to them like a wastage of resources.

So, instead of that, they go for the easiest solution that is burn it off. And we all know that the result of burning of crop refuse is very dangerous. So, it is recommended that crop refuses and waste, you can actually put back into soil, this not only keep the soil warm, it also helps to retain the moisture.It can also get degraded over a period of time by different microorganisms and thus add the soil organic carbon into the soil. So, mulching overall has important purpose in the field of agriculture and management.

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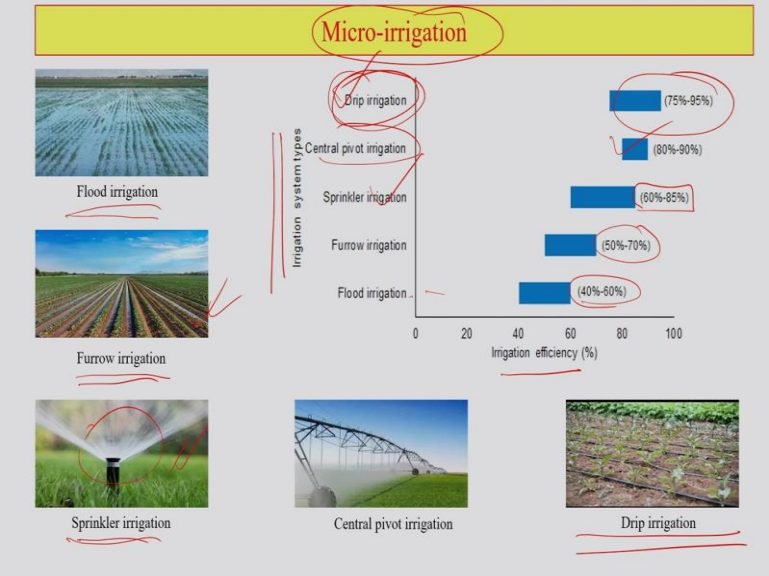

Now, the next important thing that under precision farming often people talk about is irrigation. Lot of technologies, lot of instrumentations has come into the market with regard to irrigation aspect. Now, micro irrigation especially is a field where we try to utilize as less as possible water with the maximum effect; means production of yield should be much high with the less water and from that only the concept of crop per drop has come out as a popular program in our country.

Now, we have different type of irrigation systems available agriculture system in developed and as well as developing country. Furrow irrigation; very common you can see across our country. Sprinkler irrigation in the recent time in the last one decade or so, has become popular in large farming areas, but still it is not so much popular with small farmers because again, this kind of system involves certain amount of investment. There are of course, some government schemes which are available under which government encourages farmers to go for this with certain amount of subsidies and also associated required training.

So, if you look at that the efficiency of irrigation with regard to different irrigation system, so that will tell the story that how this particular aspect; irrigation is one of the most popular farming practices under precision farming. Now, if we go for flood irrigation, your efficiency is somewhere around 40 to 60 percent. If you go for furrow irrigation, that efficiency goes a little up 50 to 70 percent. If you go for sprinkler efficiency go much higher 60 to 85 percent. Means, this shows that how much amount of water you add and how much production you get this is how you calculate the efficiency. Central pivot irrigation 80 to 90 percent and finally, if you go for drip irrigation, your efficiency would go 75 to 95 percent level.

So, naturally if you look at these things, the best option is to go for drip irrigation. Well, we in our country started popularizing drip irrigation almost 10 to 15 years to 20 years also in some cases. And if you look at that, still it has not gone into every nook and corner of our agricultural field. It will take time, because as I said that most of our farmers, they hesitate actually going for this kind of investment, because they are resource poor. So, it needs to be seen that how different kind of programs can be mainstreamed and the awareness of the farmers, how can be generated so that a large and large number of small holding farmers also come to utilize the benefit of drip irrigation.

Now, deep irrigation is very getting very popular in areas where no farming it takes place in a very large amount of land, say for Punjab and Haryana, where farmers are relatively resource rich then the farmers of suppose some parts of northeast India. So, if you look at that, largely the resource rich farmers, farmers who has relatively some amount of money to invest in this kind of technology, they are going for that.

And also they are getting the benefit of the different government schemes to encourage this kind of technology. So, the farmers who are poor in resources, sometimes even are not able to get the benefit of these technologies or the schemes. So, I think that this requires a little bit of deliberation, how to make these technologies available for all.

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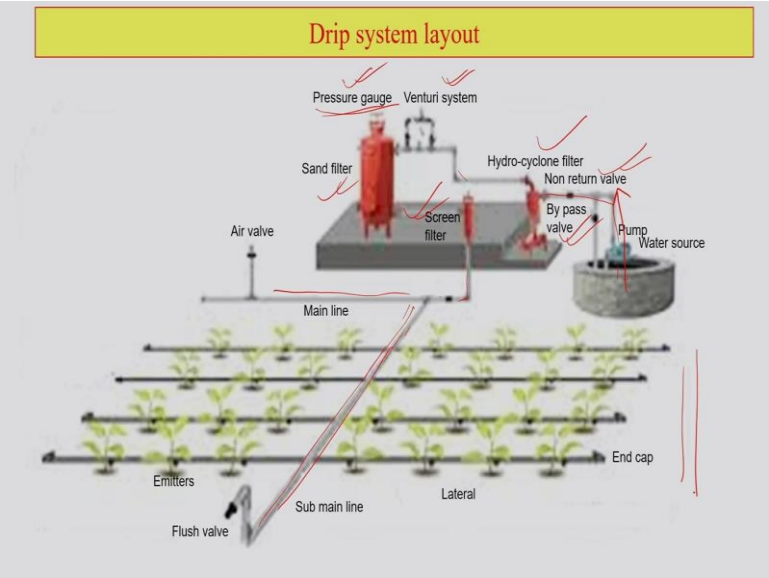

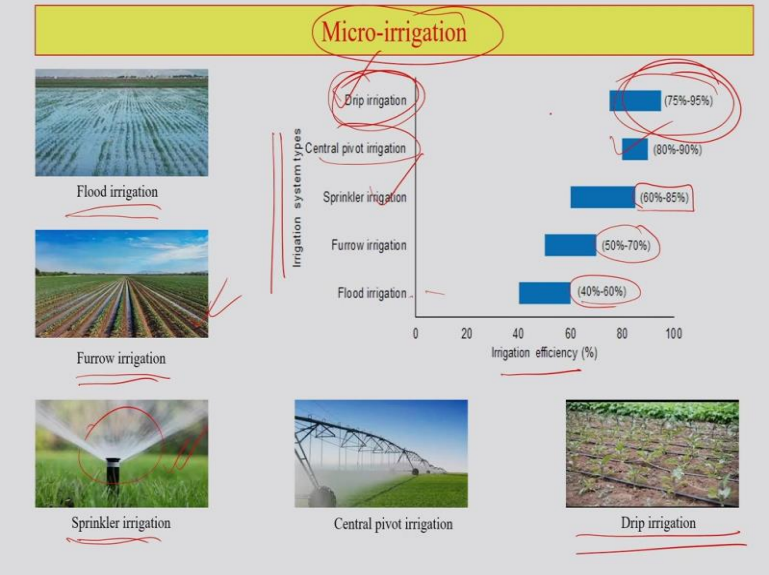

Now drip irrigation, as I said that it gives the highest amount of efficiency. So, it is enough that we spend a little time on this particular technology which is known as drip irrigation. Now drip irrigation or drip system, it has various techniques and instrumentations involved with that. So, it has pressure guage, venturi system, sand filter, screen filter, hydro cyclone filter, non return valve, by pass valve and then from here you are pumping out the water.

So, the water from the tank or the well you pump it, passes through certain filtration process and then finally, it comes through the pipe and then pass through the farming area. Now, there are various kind of materials recommended for this kind of drip irrigation. Some places especially north eastern India, people can use even bamboo; there are various reports are available, where it shows that even bamboo can be used as a conduit for drip irrigation.

So, the challenge is as I said that earlier also that even if technology is available, the challenge is how to make it a low cost on. Utilizing the resources which are available locally and for that a lot of research and innovation is required. Now, as I said that, drip irrigations once you invest it helps actually to develop your production and productivity.

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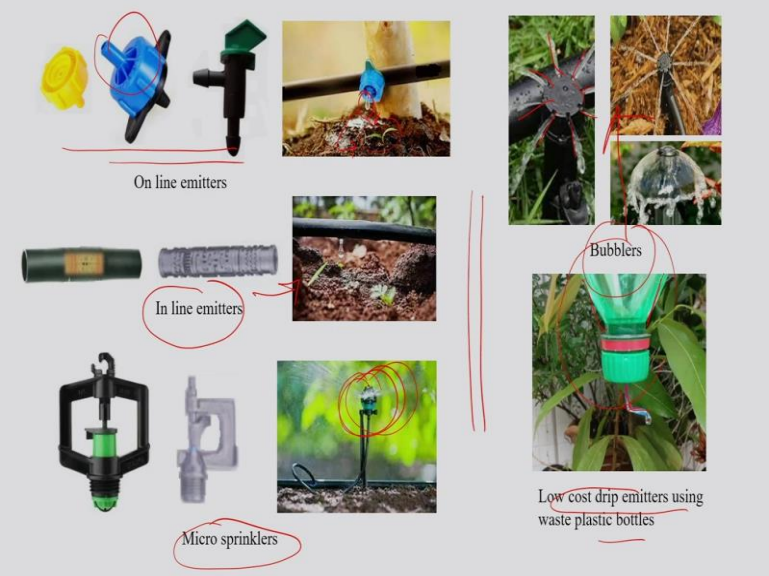

So, if you look at the pipe based irrigation, drip irrigation system, there are various parts are involved for this kind of system. Now, you have different kind of Emitters means through which the water comes out from the delivery pipes. So, as you see that here is one system where it is used here for as a water drop. So drop by drop the water will fall on the soil and it will be taken up by the plant. So, essentially you reduce the amount of water flow and you give that much which is required for your plant.

Now, this is another system where water is coming out from multiple holes and getting spreaded across the field. Llargely in the lawn golf court you will see that this kind of rotating kind of emitters is used. We have also bubblers in the system, bubblers you can see here and then low cost deep emitters using waste plastic bottles are also used. This is in bottle basically inverted bottle and then on the cap you add a small straw even you can use the straw that you use for sipping juice or cold drinks that can also be used as a pipe to pass on this water drop by drop.

So, in the market, nowadays we have inline emitters as well as you see here in this picture and also we have micro sprinklers. So, these are micro sprinklers as I said that largely used in golf courses and also where you like to have a very nice green grassy patch. So, there you can use these kinds of micro sprinklers. Now, the ultimate objective of these kinds of instruments is that you maximize the utilization of water. So, with every drop of water you get a crop. So, water for plant is life; for us also.

Now, if you give extra water then what the plant requests, where it will go? Either it will go away from the system or it will go in the groundwater. So, again to utilize back that water it takes time. So, instead of that, whatever resources that we have, if we can enhance the efficiency of that water use, then definitely we can grow more than one crop utilizing the similar amount of water. So, this drip irrigation technology helps us to maximize our production and minimize the water uses.

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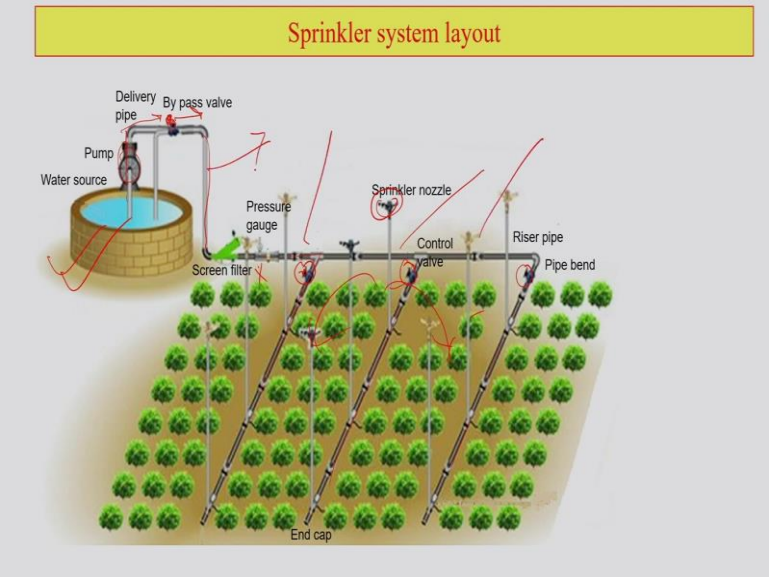

How it looks like if you look at a sprinkler system. So, as I said that in large field golf field or in an area where beautiful green grass patches are there, you will see that sprinkler system is working. Now, there is the source of water and you have a pump. This pump take away the water passes through a delivery pipe, you have a valve here which can regulate the water flow with when you want to stop you can just close this valve and water supply will stop. So, this water will come here and then it will pass through these parallel channels. Every channel will have another valve, so you can control it also, row wise also you can control. If you do not want in this row water, you can close this valve here but continue with these two.

So, these control valves also help to regulate the water flow and the irrigation as per the requirement of the crops. So, these are sprinkler nozzles as I said this keeps on moving and sprayed the water from both sides of the field. So, this particular system is very easy actually to maintain does not require too much of skill. Only thing is that little bit of investment that you may need to install these kind of structures.

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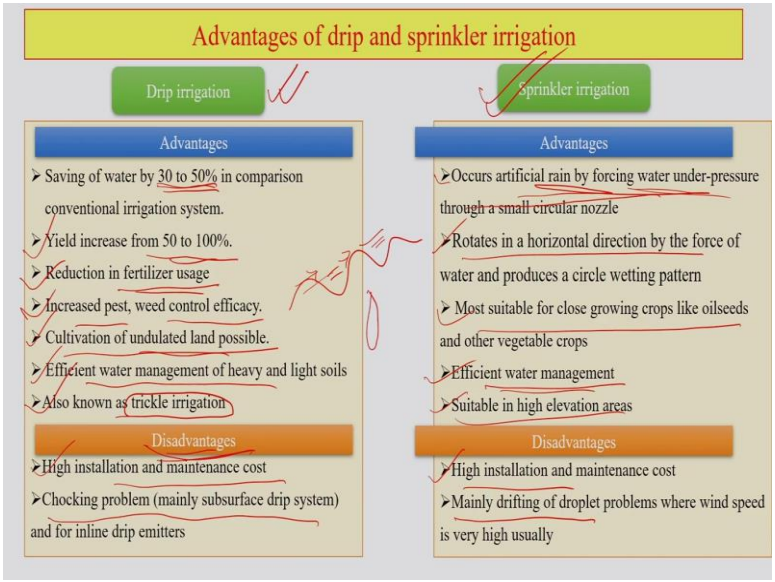

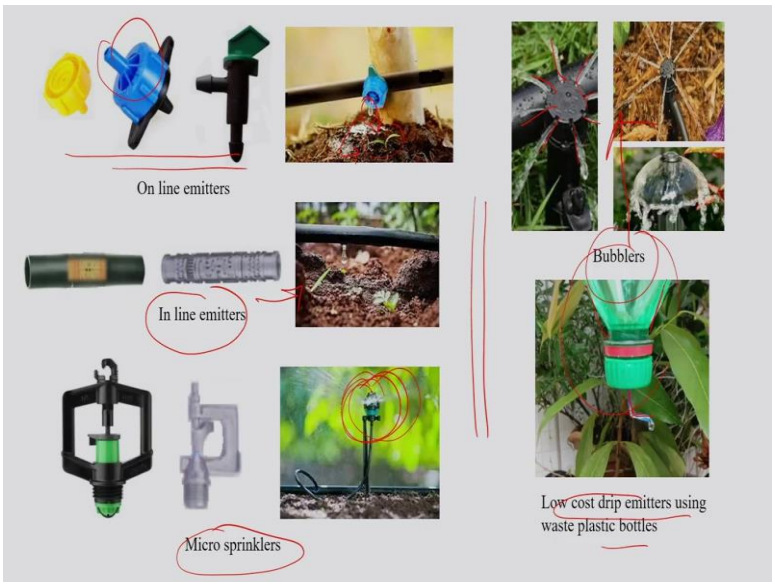

Now, what are the advantages of drip and sprinkler irrigation? Now, first drip irrigation, the advantages like it helps you to save water by 30 to 50 percent in comparison to conventional irrigation system, where you cut the field and allow the water to come in from the channel. So, 30 to 50 percent saving water is a significant amount especially in area where rainfall is very uncertain and dry soil. You can actually increase yield from 50 to 100 percent by drip irrigation.

Reduction in fertilizer usage is also possible. Increased pest and weed control efficacy through deep irrigation; your efficiency of controlling weed pest is also higher; cultivation of undulated land is also possible. Now, many cases in undulated land what happened that

people avoid crops of plantation because it is very hard to manage what you call conventional irrigation in this kind of land. So, you can go for drip irrigation.

Efficiency, water management of course, as I say time and again it could be efficient in a heavy or light soil. It is also known as trickle irrigation because it comes in drop by drop. Few disadvantages also for drip irrigation; as I say that it requires high installation and maintenance cost. There is always a chance of choking; problem mainly for subsurface drip system and also for inline drip emitters. So, that choking systems needs to be maintained properly. If the supply line is clean and also the emitters are checked in regular interval.

Sprinkler irrigation, advantages, so, it can create a kind of artificial rain by forcing water under pressure through a small circular nozzle as you saw here. So, this is a sprinkler. So, it can actually create a kind of a artificial kind of rain systems. Now, it also rotates in a horizontal direction by the force of water and produces a circular waiting pattern.

So, that helps actually, it can take care of right and left hand side of it and can cover a certain area. Most suitable for close growing crops like oil seeds and vegetables, sometimes fruits also. It is very efficient for water management and of course, it is suitable in case of high elevation area in the mountain areas.

But again sprinkler irrigation also has certain disadvantages, it is also high installation and maintenance cost is very high. Mainly drifting of droplet problems occur in this system, where wind speed is very high you have certain issue because the sprinkler when it actually runs the small droplet instead of going in the direction that you want it to go because of strong wind it might go away from the targeted area. So, those are small disadvantages associated with both drip and sprinkler irrigation.

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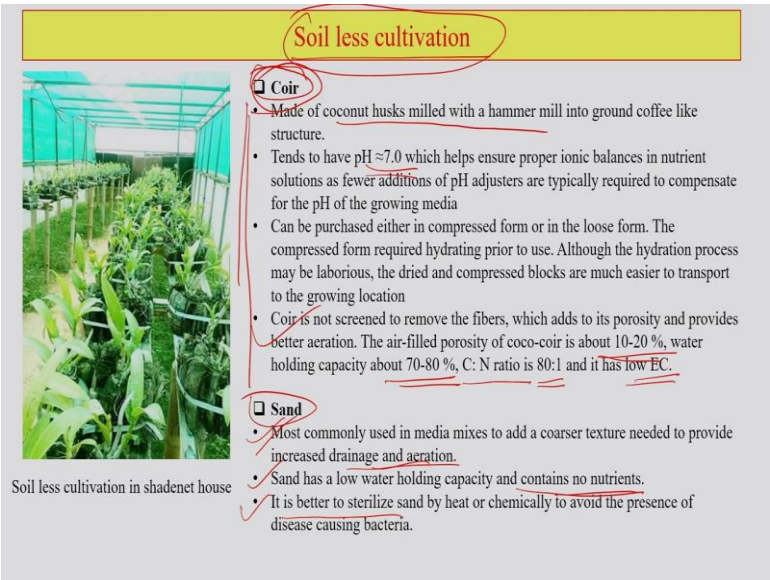

Now, let us discuss another new aspect of precision farming which is becoming very popular in these days when our land area is increasingly getting smaller and smaller. So, the challenge is to grow more from less area. Now that is why soil less cultivation has become a kind of a new trend where you can use instead of soil various other materials to grow your plant. One of those very popular materials is coir which you get from coconut plant. So, coir which is made of coconut husk can be used as a material in place of soil.

Coir tends to have a pH 7, which is very good for agricultural purposes and ideally, we look for neutral range soil. So, coir can provide you that kind of environment. Coir can be purchased either in compressed form or in loose form. The compressed form requires hydration before you use it.

Although the hydration process maybe labor intensive, the dried and compressed blocks are much easier to transport from one area to the other area. So, for suppose, you are buying it in place A and your farm where actually you are going to grow crops with utilizing this coir is say 5 kilometer arriving from that area. In that case, the dry compressed blocks of coir is better to carry or transport.

Coir is not screened to remove the fibers. This adds its porosity and also provides better aeration, the circulation of air would be better. The airfield porosity inside the coco-coir, or coconut coir is about 10 to 20 percent and its water holding capacity is about 70 to 80 percent. If you look at the C:N ratio, it is 80 is to 1 and it has a very low electrical

conductivity. Now, these are certain characteristics of coconut coir, which makes it an alternative media of crop growing in place of soil.

Sand; I think is not something new. Many of us we have seen that sand is used as an alternative media for growing plants, most commonly used in media mixes to add a kind of a coarseness and it is required to provide better drainage and also aerations. So, sand has a low water holding capacity. It is coarse in texture and it also contains almost no nutrients into heat.

So, there are few problems with sand. We know that but sand is better to sterilize by heat or chemical way to avoid the presence of any kind of pathogens in sand, which often in case of soil, we find that issue. So, that means if you grow your plant in sand, there is a less chance that you may require any kind of chemical pesticides or chemical inputs for maintaining this plant growing.

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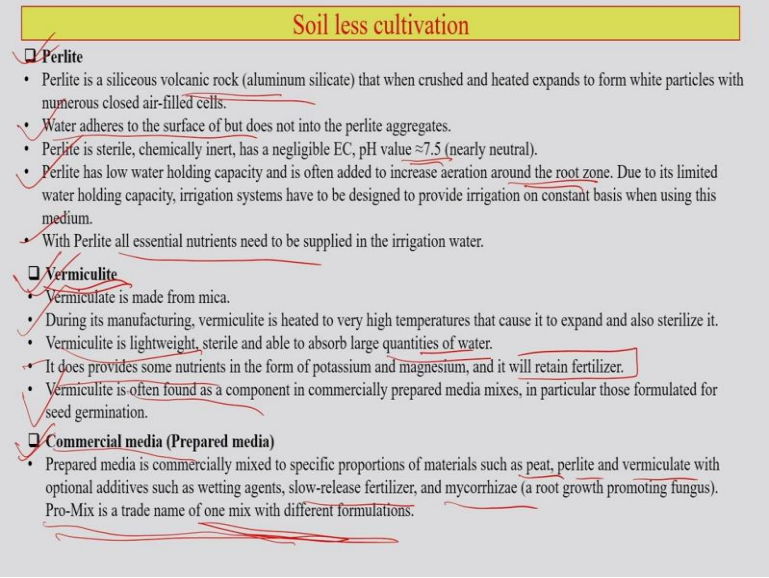

Now, in case of soil is cultivation, there are a few other aspects that we need to keep in mind like perlite, vermiculite and commercial media. These are some of the things which in case of soil less cultivation, we need to keep in mind. Perlite is a siliceous volcanic rock material that when you crush it, and when you heat it, it expands with a lot of air-filled-cells into it.

So, that means it will have some already pore spaces or cells filled with water. So, water adheres to these kinds of surfaces, but does not in this kind of perlite aggregates. Perlite aggregates is sterile in nature chemically inert and has a negligible electrical conductivity. pH

value is 7.5 roughly near neutral I could say. Perlite has low water holding capacity and is often used to increase aeration around the root zone area of the plant.

Now, due to its limited water holding capacity, irrigation system have to be designed or maintained to provide water on constant basis when you grow plant in this kind of material. With perlite, all essential nutrients need to be supplied through the irrigation water. That is one aspect or challenge in growing crops in this kind of material.

Vermiculite; vermiculite is made from mica. Now during its manufacturing, vermiculite is heated to a very high temperature and ultimately which leads to expand this material and also help in sterilizing it. Vermiculite is also lightweight, sterile and able to absorb large quantities of water. That is one good thing in this particular material.

Vermiculite provides some nutrients in the form of potassium and magnesium and most importantly it retains the fertilizer into it. Vermiculite is often also found as a component in commercially prepared media mixes that is available in the market and in particular those which are formulated for seed germination. So, many crops we required that seeds to be germinated in one system and then you grow it in another system, vermiculite help in this particular purpose.

Now, commercial media; prepared media which are available in the market, these medias are commercially mixed to a specific proportion of material like say peat, perlite, vermiculite with different additives, like some wetting agents, slow-released fertilizer, mycorrhiza. So, these things are mixed in a manner that it gives you the best mix for growing plant into this.

So, Pro-Mix kind is a trade name of one such mix with different formulation. But again, remember this kind of commercial media based culture is not yet very popular in our country, because this requires again some investment and that is why probably private parties and contract farming probably they can go ahead with this kind of technology. But soil less cultivation certainly has a potential and it is a futuristic kind of practice, which needs to be looked at and required R and D must be carried out on this particular technology.

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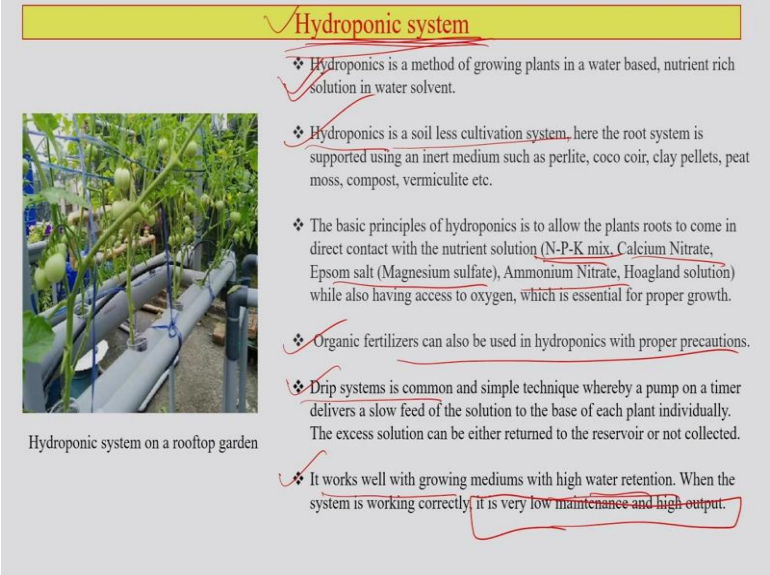

Next, we will talk about hydroponic system which has to do with maintaining or management of water. Hydroponic system is another new technology under precision farming, which has become popular in many parts of the world. And also we can see that in certain parts of our country, some individual parties are actually utilizing these for contract farming or for individual uses. Hydroponics basically is a method of growing plants in water based nutrient rich solution, but not soil. So, the water is made in such a way that it provides the all the nutrients that the plant would require or try to take out from natural soil ecosystem.

Hydroponics is a soil less cultivation system. Here the root system is supported using an inert medium such as perlite, coco coir, clay pellets, peat, compost, vermiculite, etc. Now, the basic principle of hydroponics is to allow the plants roots to come in direct contact with the nutrient solutions that you are putting there. Nutrient solution means different micro, macro nutrient like nitrogen, phosphorus, potassium mixture, calcium nitrate, ammonium nitrate; these are the different nutrients solutions, which actually plant requires for its appropriate growth.

Organic fertilizer can also be used in hydroponic system, but with proper precautions, because organic fertilizer can attract pathogens and in this kind of system in hydroponic system, if pathogen infestation takes place, it will be really very harmful or it can actually take away the total planting system.

Now drip system is very common and simple technique which can be used for providing even solutions to each of the plant individually and the excess nutrient solution can be either

returned back to the reservoir or we may not even prepare that solutions, if we know the exact amount of nutrients that is required for a particular plant and that that comes with little bit of experiences, while you actually run this kind of system for some time.

Hydroponic system also works well with different growing medium, with high water retention. And when the system is working correctly, it is a very low maintenance and high output system. And that is why hydroponic system is getting increasingly popularity across the world and especially areas or countries where water availability is a big issue.

So, that is why this system, hydroponic system is also another futuristic technology which is already here. We have it in India also and this considers the situation, suppose in future if we get scares amount of water already some parts of the world is facing the water scarcity. Hydroponic system could be an alternative answer or befitting answer to this kind of water scarcity situation.