Soil Fertility and Fertilizers
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Week 5
Lecture 23
Soil micronutrients and their role in plant nutrition (Contd.)

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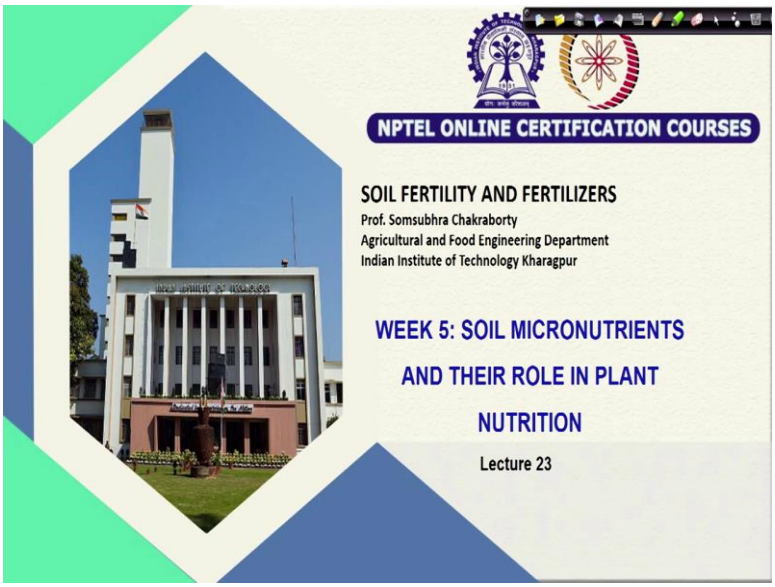

Welcome friends to this lecture number 23 of Nptel online certification course of soil fertility and fertilizers and in this week we are talking about this week 5, and in this week we are talking about micronutrients and their role in plant nutrition.

So, in our previous lectures, we have discussed about basics of micronutrients and there are different factors which can affect the micronutrient availability in the soil, we have also discussed the micronutrients cycle, we have also discussed the some of the deficiency symptoms and what are the critical ranges of different micronutrients within the plant we have also discussed.

Now, in this lecture we are going to discuss the deficiency symptoms of the micronutrients in the plant also we can also we will discuss the boron fertilisation in in soil and what are the consideration of boron fertilizers application in soil.

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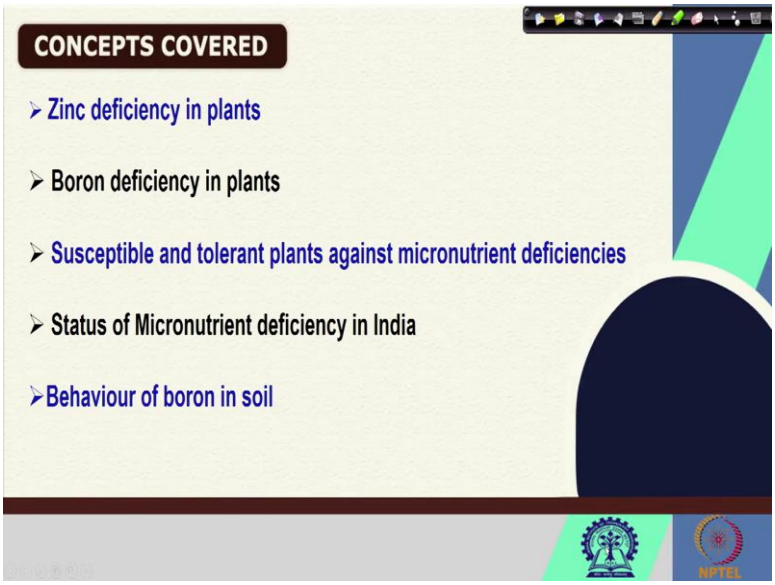

So, these are the concepts which we are going to cover in this lecture. First of all, we are going to talk about the zinc deficiency in plant then we are going to talk about boron deficiency in plants. And then, we are going to talk about the susceptible and tolerant plants against micronutrient deficiencies. And then we are going to talk about micronutrient deficiency status in India and then behaviour of boron in soil. So, these are the major concepts which we are going to cover in this lecture.

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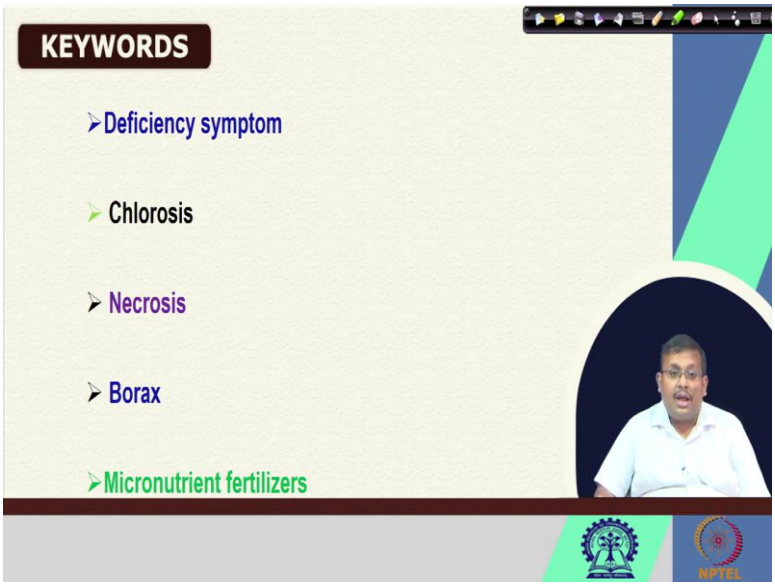

Secondly, these are the keywords which are going to discuss in this lecture deficiency symptoms chlorosis, necrosis, borax and micronutrient fertilizers.

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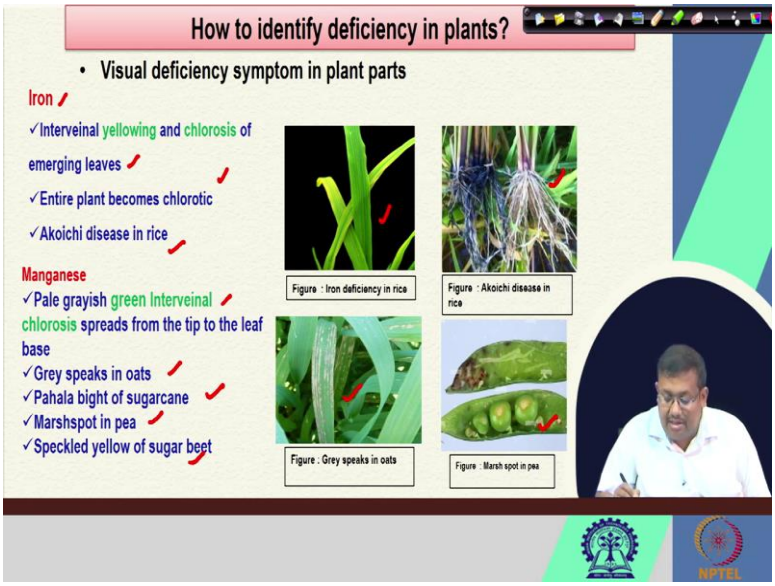

Now, how to identify the deficiency in the plant? So, there are some visual deficiency symptoms in different plant parts. So, just like in case of primary nutrients and secondary nutrients micronutrient deficiency are also can be seen visually let us discuss some of them. So, first is iron. In case of iron we can see interveinal yellowing and chlorosis of emerging leafs, entire plant becomes cholorotic and also we can see akoichi disease in rice.

So, these are the some of the iron visual deficiency symptoms. In case of manganese, we can see pale grayish green interveinal chlorosis spreads from the tip to the lip base and also we can see grey speaks in oats, and then pahala bight of sugarcane, Marshspot in pea and also speckled yellow of sugar beet.

So, we can see this is an example of iron deficiency in rice. So, this is a iron deficiency symptom in rice. This is the akoichi disease in rice, and you can see grey specks in oats and Marshspot spot in pea. So, these are the deficiency symptoms of these micronutrients, specifically iron and manganese.

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Now, if we talk about the zinc deficiency, leaf base of younger leaves become chlorotic brown and blotches and streaks or can be can be seen on lower leaves. And then we can see Khaira disease of rice it is a very important disease Khaira disease of rice, due to zinc deficiency, then white bud in maize and sorghum and their little leaf in brinjal, cotton and mango and also ferm leaf of potato.

So, these are the some of the Zinc deficiency symptoms. In case of copper, we can see leaves develop chlorotic and streaks on either side of the midrib and then dark brown necrotic lesions on leaf tips and bluish green and chlorotic patches near the leaf tip, diebacks in, dieback in citrus, steam melanosis in wheat, excess gumming and also exenthema in citrus.

So, these are some of the symptoms of nutrient deficiency in in the soil. So, we can see this is example of Khaira disease in rice due to zinc deficiency, then little leaf in brinjal. You can see this is also due to zinc deficiency. Here you can see copper deficiency symptoms and also dieback in Cyprus due to copper deficiency. So, these are the deficiency symptoms of these 2 major micronutrients.

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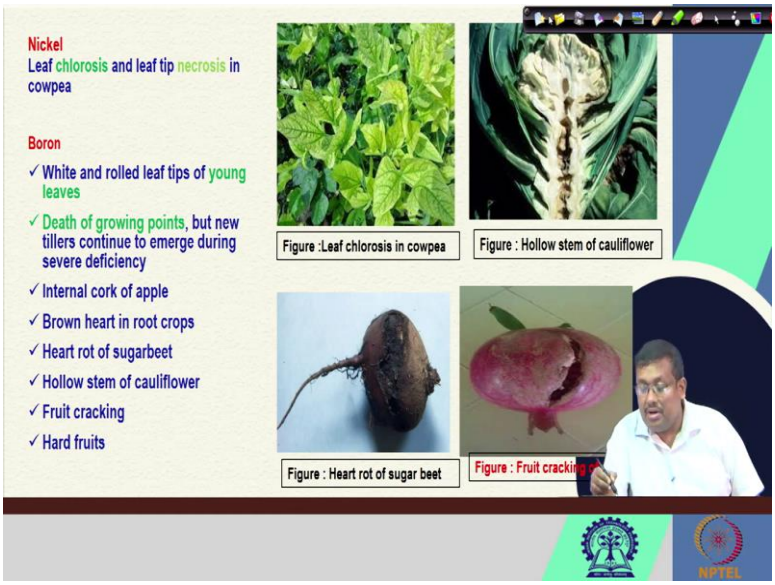

So, if we talk about the nickel deficiency symptoms and boron deficiency symptoms. So sorry now, if we talk about the nickel deficiency symptoms and boron deficiency symptoms, in case of nickel leaf chlorosis and leaf necrosis in cowpea can be seen.

In case of boron, we can see white and rolled leaf tips of younger leaves then death of growing points. However, new tillers continue to emerge during severe deficiency.

Internal cork of apple and then brown heart and root crops, heart rot of sugarbeet, hollow stem of cauliflower, fruit cracking, hard fruits all these are symptoms of boron deficiency. So, here as you can see, this is a leaf chlorosis in cowpea, which is due to that nickel deficiency.

And also in case of cauliflower you can see this a hallow stem due to, this is due to boron deficiency. This is heart rot of sugar beet burn due to boron deficiency and fruit cracking of pomegranate, which is also the the boron deficiency due to the boron deficiency. So, these are the nickel and boron deficiency symptoms.

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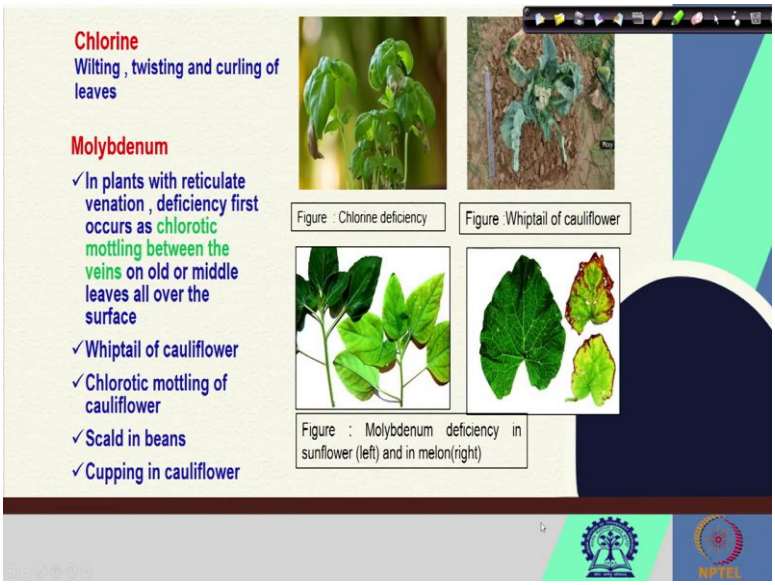

Now, in case of chlorine, we can see wilting, twisting and curling of the leaves you can see chlorine deficiency symptoms here leafs are getting curled and then molybdenum in plants with reticulate venation deficiency first occurs as chlorotic modelling between the veins on old or middle leaves all over the surface.

And also we can see whiptail of cauliflower here you can see whip tail of cauliflower then chlorotic mottling of chloric of quality of cauliflower and then scaled in beans we can also see and also cupping in cauliflower these are some of the symptoms and also here you can see molybdenum deficiency in sunflower. So, this is a sunflower and in Melon. So, these are some of the deficiency symptoms of chlorine and molybdenum.

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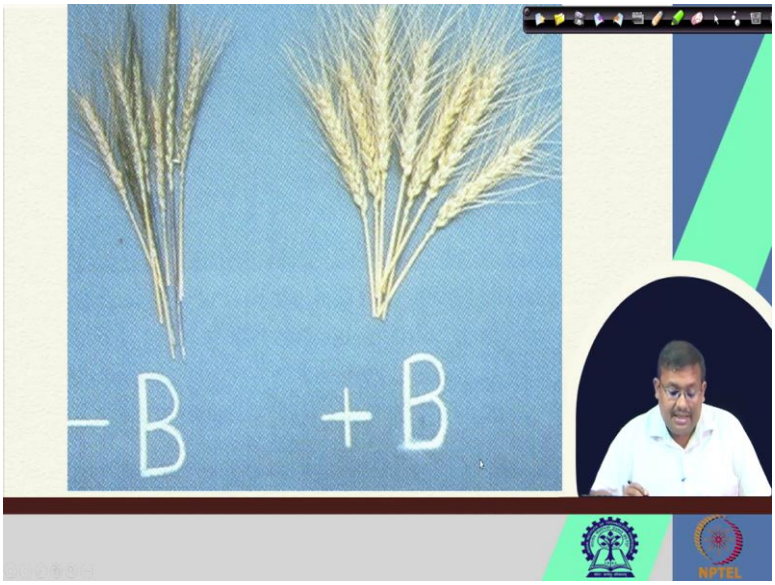
B deficiency



Vertical splitting in carrot root due to Boron deficiency

Groundnut - hollow heart and eventual discoloration due to B deficiency

B deficiency

So, this is also showing the zinc deficiency in rice and then iron deficiency you can see chlorotic leaves then boron deficiency there is a hollow stem in cauliflower and you can see these a boron deficiency in weight and disease, weight with optimum boron concentration. This is a vertical splitting in carrier root due to boron deficiency.

This is ground nut in case of groundnut we can see hollow heart and eventual discoloration due to boron deficiency. And you can here also see boron deficiency in tomato and you can clearly see the difference there in 1field application of NPK 10, 26, 26 with borax and without borax. So, you can clearly see the difference in the in the crop growth. This is molybdenum deficiency symptoms.

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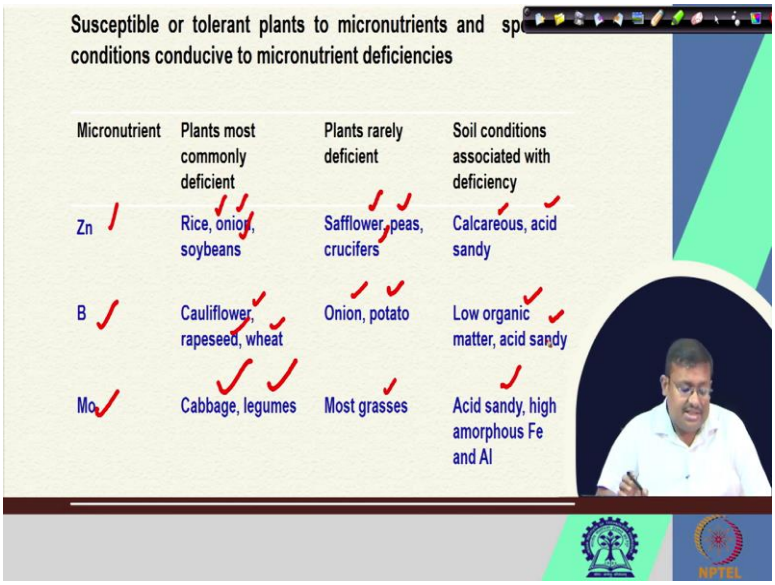

So, now, we have seen that deficiency symptoms of the plant due to different micronutrients let us discuss some of the susceptible or tolerant plants to micronutrients and specific condition conducive to micronutrient deficiencies.

So, if we see the, as for zinc, the plant most commonly deficients are very much sensitive crops or rice, onion and soybean and plants which was rarely deficiency symptoms are safflower peas and crucifers, crucifers means mainly the cauliflower and then soil condition associated with the deficiency or calcareous and acidic sandy soils.

So, in case of calcareous an acidic sandy soil you can see these micronutrient is zinc is deficient. Boron we can see the plan most commonly deficient or cauliflower, rapeseed and wheat and plants which was rarely deficiency symptoms are onion and potato and then soil conditions which are generally associated with deficiency or low organic matter and acidic sandy soil.

In case of molybdenum, we can see the deficiency symptoms mostly in cabbage and legumes. However, most grasses do not show any mild molybdenum deficiency, soil conditions which are associated with the deficiencies are acidic sandy soil, high amorphous iron, aluminium contents. So, these are some of the conditions where you can expect some molybdenum deficiency.

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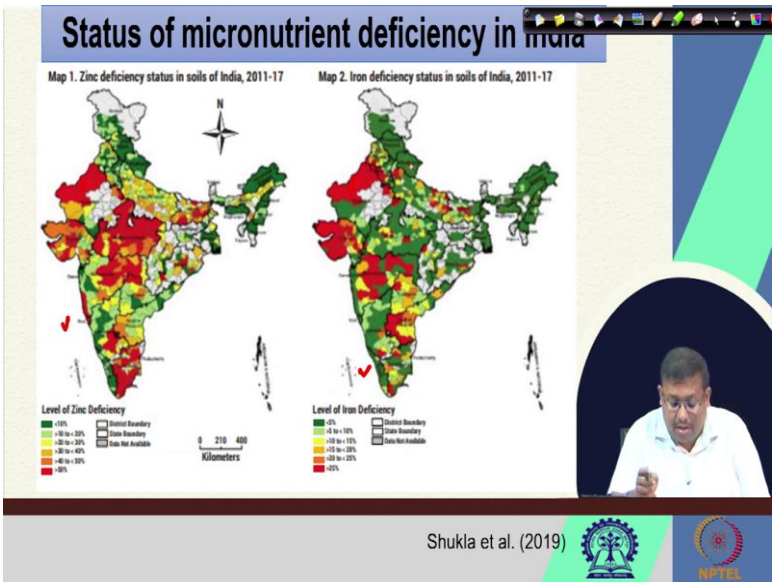

Now, if you see the status of micronutrient deficiency in India, this shows this graph, this map shows the level of zinc deficiency and this map shows the level of iron deficiency. So,

you can see these green patches are showing less than 10 percent of zinc deficiency and these red patches are showing high amount of zinc deficiency and these brown and these orange patches are showing also more than 40 to less than 50 percent of levels of zinc deficiency.

So, you can see in Tamil Nadu and also some parts of Madhya Pradesh and also some parts of Rajasthan can show these high zinc deficiency symptoms. However, in case of iron deficiency you can see in Rajasthan and Gujarat, these we can see more than 25 percent of iron deficiency and also some patches in Maharashtra and Andhra Pradesh and Karnataka, we can see these nutrient deficiency of iron in soil.

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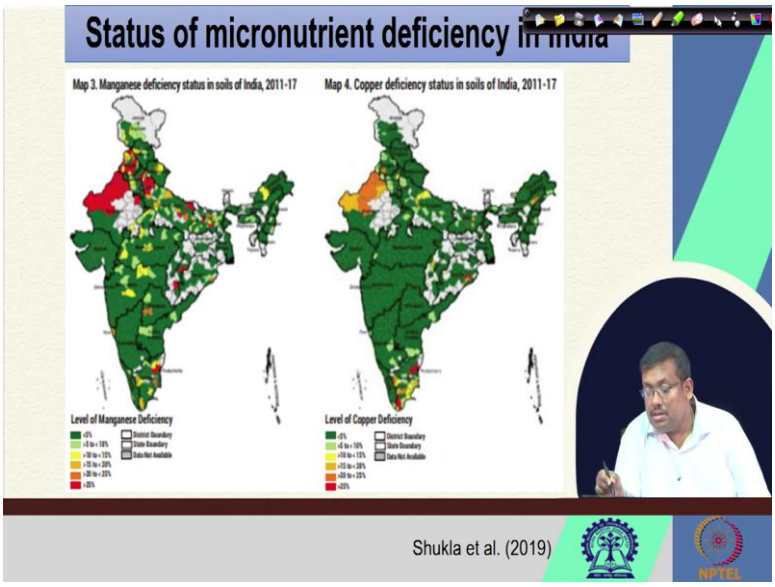

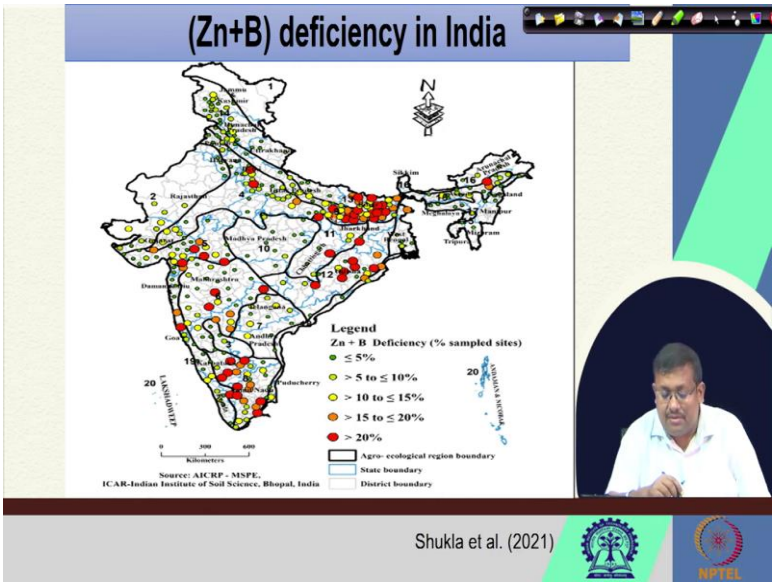

So, this map shows the level of manganese deficiency manganese deficiency can be mainly found in Rajasthan area and in some areas of Punjab, where we can see more than 25% of manganese deficiency in case of copper deficiency we can also see some copper deficiency in Rajasthan area.

So, if we combine both zinc and boron deficiency that is among all the percentage of sample sites from all over the India we can have an idea about where we can see these 2 macronutrient deficiencies. So, these 2 micronutrient deficiency can be seen in in in some parts of in some parts of Bihar and Jharkhand and also we can see these is some parts of Orissa, some parts of Tamil Nadu, Karnataka and also some parts of Gujarat and Goa.

So, these are some of the areas and some parts are up also, we can see the severe that is more than 20 percent of zinc plus iron deficiencies. So, these 2 are made major, these 2 micronutrients produce the major deficiency of micronutrients in Indian condition.

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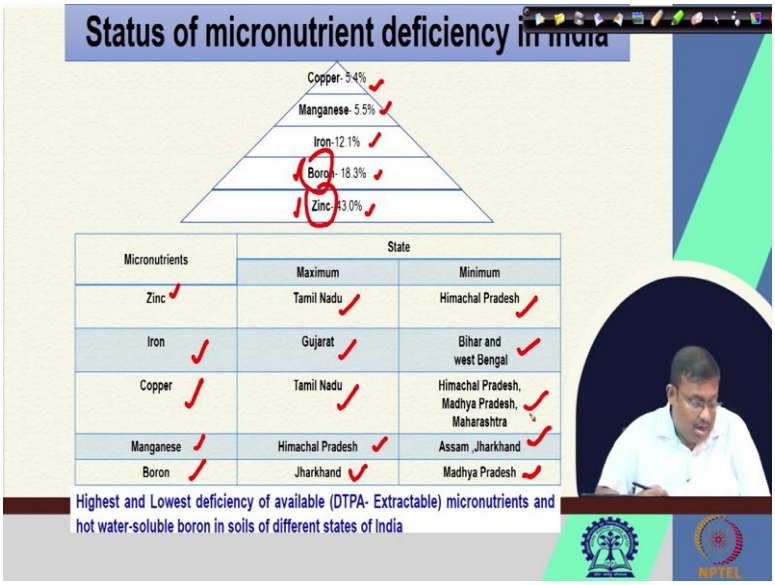

So, if you see the status of micronutrient deficiency in India, it will be quite clear that zinc accounts were 43 percent followed by boron, then which shows, which accounts for 18.3 percent followed by iron that is 12.1 percent followed by manganese which is which accounts for 5.5 percent and followed by copper which is 5.4 percent. So, we can clearly see that zinc and boron are the 2 major micronutrients of concern because they show huge amount of deficiency in Indian soil condition.

So, if we see the, the micronutrients and the highest and lowest deficiency of available micronutrients and hot water soluble boron in soils of different states we can see in case of zinc, the highest deficiency symptoms we can see in Tamil Nadu and lowest in Himachal Pradesh.

In case of Iron, the maximum deficiency you can see in Gujarat and lower low deficiency low is deficiency symptoms you can see Bihar and West Bengal in case of copper we can see highest deficiency in Tamil Nadu and lowest deficiency in a Himachal Pradesh, Madhya Pradesh and Maharashtra in case of manganese we can see highest deficiency in Himachal Pradesh and lowest deficiency in Assam and Jharkhand.

In case of boron we can see highest deficiency in Jharkhand. However, the lowest deficiency we can see in Madhya Pradesh. So, these are showing the highest and lowest availability of the micronutrients in soil.

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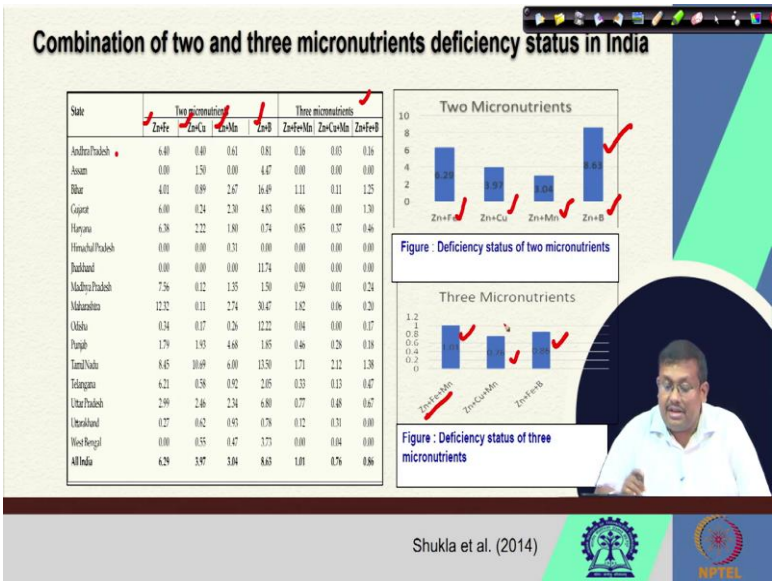

Now, if you see the combination of 2 or 3 micro deficiency status in the soil we can see that 2 micronutrients like zinc plus iron, zinc plus copper, zinc plus manganese and zinc plus boron. This table shows the state wise deficiency status for Indian condition for all these different combinations and when there are the 3 micronutrients are combined, these are the distribution of the deficiencies across all the states.

So, you can see zinc plus iron shows, zinc plus boron shows the maximum deficiency symptoms followed by zinc plus iron and the zinc plus copper and zinc plus manganese. So,

when we consider 2 micronutrients combination, zinc plus boron accounts for the major micronutrient deficiency in the plants. In case of deficiency status of chain you can see zinc, iron, manganese shows the highest deficiency followed by zinc, iron and boron and zinc, copper and manganese. So, these are the status of micronutrient deficiency in different parts of India.

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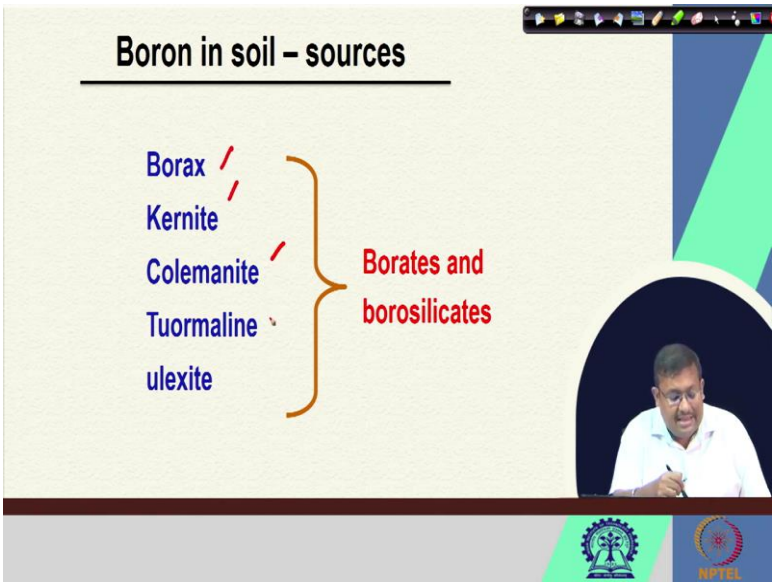

So, if we talk about boron, so, what are the sources of boron in the soil. So, these are the major sources of boron in soil, Borax, Karnite, colemanite and then tuormaline and ulexite. So, these are the major sources of boron. So, these are basically Borates and Borosilicates. These are the major sources of boron in soil, these are the minerals.

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So, if we consider boron in soil, total boron concentration in soil depends on parent material and the degree of weathering with natural background concentration usually, which ranges from 2 to 100 ppm. Now, boron is never found as a single element and is usually combined with oxygen as Borates. And boron may also be tightly bound in silicate minerals to produce very insoluble minerals such as clay minerals or tourmalines. And remember that adsorption on oxides and association with organic matter can be seen in case of boron in soil.

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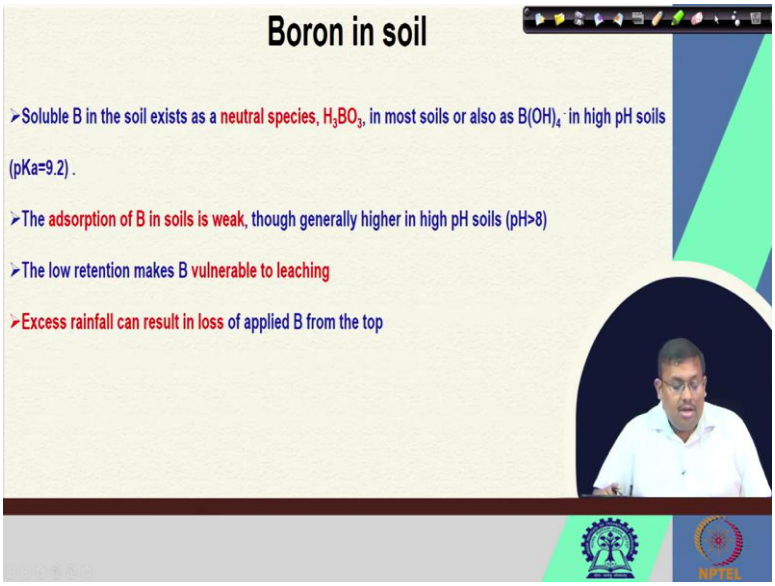

Now, soluble boron in the soil exist as neutral species, which is boric acid in most of the soil as well as this ionic form in high pH soil. Now, the adsorption of boron in soil is weak though

generally higher in pH soil, in high pH soil, when the pH is greater than 8, the low retention makes boron vulnerable to leaching and excess rainfall can result in loss of applied boron from the top of the soil.

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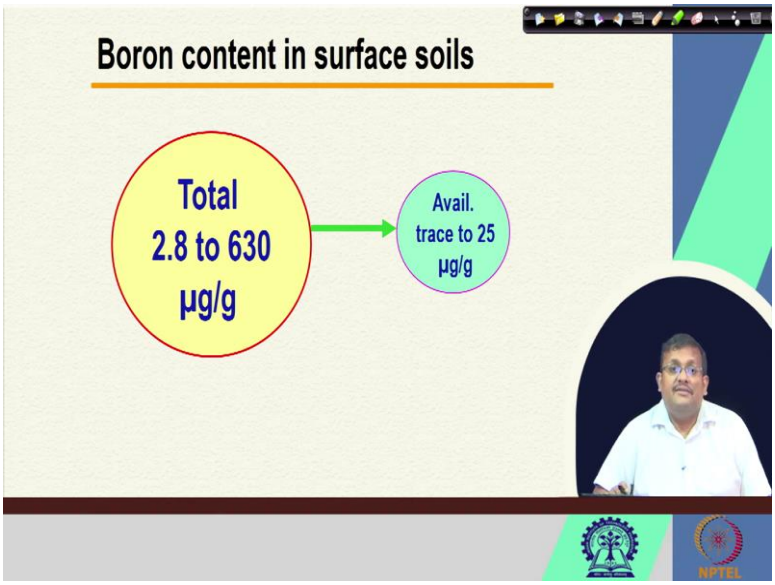

So, if we see the boron content in surface soil of course, the total boron content can vary from 2.8 to 630 PPM however, the availability of the boron is very less varying from trays to only 25 ppm. So, that is why boron management is very critical.

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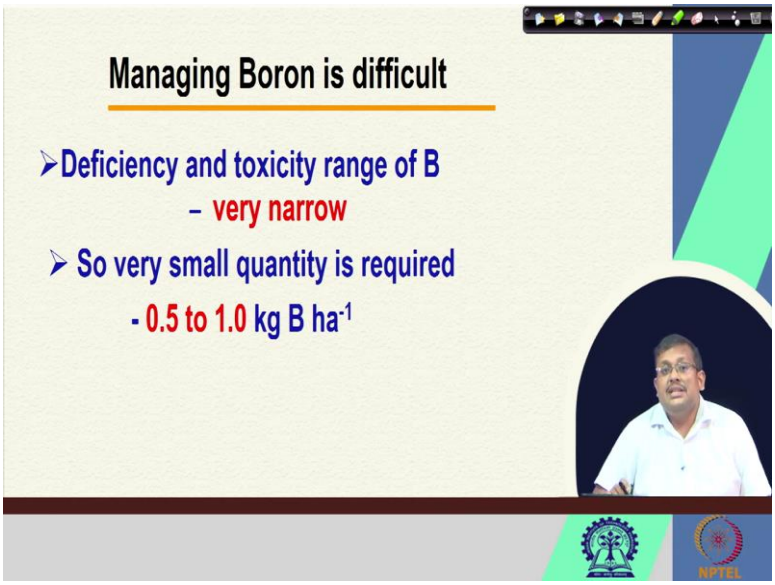

So, boron management is difficult because deficiency and toxicity range of boron is very narrow. So, very small quantities required which is varying from 0.5 to 1 kg of boron per hectare, to correct any boron deficiency symptom.

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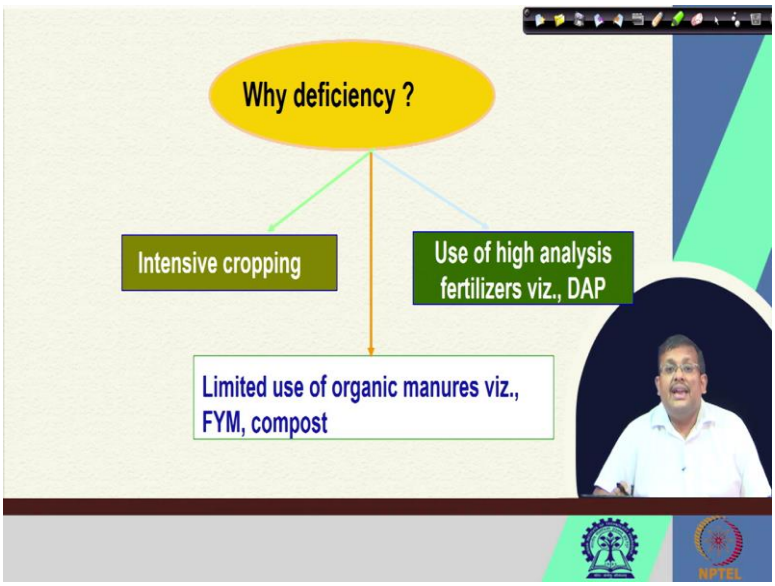

Now, why boron deficiency is a widespread problem in India. There are several reasons first of all, intensive cropping is one of the major reason of boron deficiency and limited use of organic manures like FYM compost is another reason for Boron deficiency. And finally, use of high analysis fertilizers such as DAP is another cause of boron deficiency.

So, these boron deficiency symptoms because when we apply these high analysis fertilizer, which does not contain any particular micronutrient that can vigorously grow the crop help in vigorous growth of the crop, but the problem is that enhances the micronutrient demand or in other words, micronutrient deficiency.

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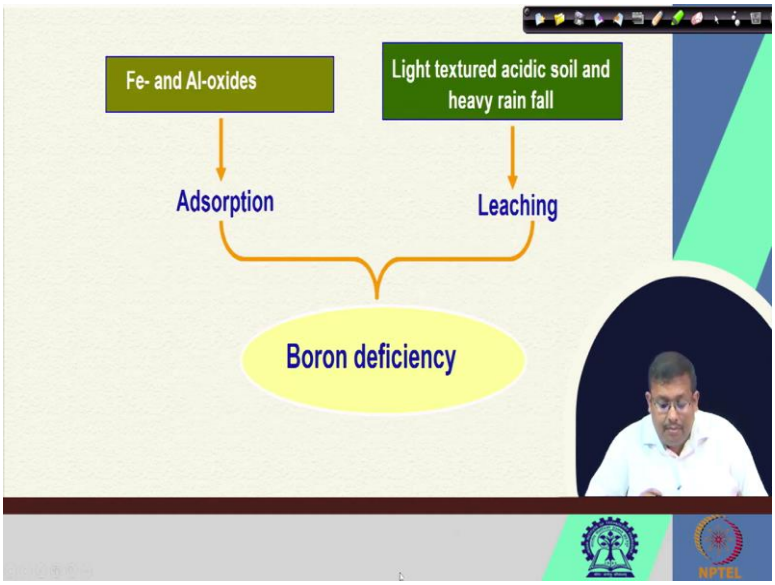

Now, boron deficiency can be aggravated by these iron aluminium oxides, because they helps in adsorption of boron and also light texture, acidic soil and heavy rainfall can also help you know can increase the leaching of the boron from the topsoil and ultimately creating the boron deficiency.

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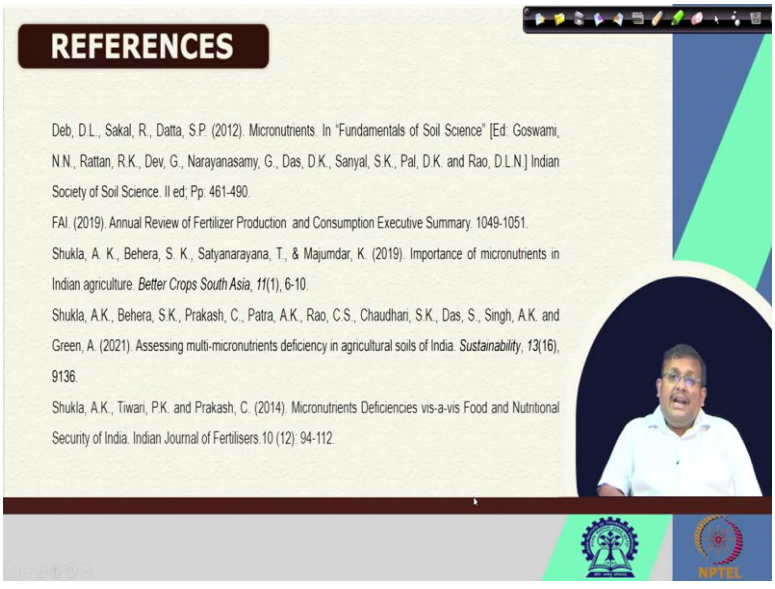

So, guys, this makes the end of our discussion of this deficiency symptoms of different micronutrients in the plant and we have discussed the Visual deficits, symptoms of different elements within the plant body. And also we have discussed the boron management in the soil, why boron is deficient and then what are the sources of boron, and we have also

discussed the nutrient deficiency status in India, where we can see that the zinc and boron accounts for the major micronutrient deficiency in India.

And we also have identified those areas within India which can show high nutrient deficiencies specifically in terms of micronutrients, those patches which shows the micronutrient deficiency for individual micronutrients.

So, we have discussed this thing. We will continue to discuss all these aspects in our coming lecture, and we will discuss more about these in our coming lecture. Till now, thank you very much and let us meet in our next lecture.