Farm Machinery
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Lecture - 19
GPS based automatic Variable rate fertilizer applicator

Well welcome students. So, far we have been discussing about seed come fertilizer drills, seed drill and planters and transplanters etcetera. Now, I will tell you another level of technology that we have developed at IIT Kharagpur, which is GPS based automatic variable rate fertilizer application.

We know that generally the nitrogen, potassium, phosphorus; NPK are the most important nutrients which are applied in the in the crop at various levels. Generally, a nitrogen is the one which is applied in different doses and potassium phosphorus are not in those number of doses. Now, question is, how do we know what is the amount of nitrogen which is already available in the soil?

It is important to know how much of the nutrient is already present in the soil because the soil is already has another crop previous crop another previous crop there could be some now nitrogen fixing crops taken. So, it is possible that nitrogen is already there in that the field. So, it is very important to know what is the amount available at particular location in the field and how much we should apply; so, that we save there. So, on that basis we created we have designed one GPS based automatic variable rate fertilizer application system.

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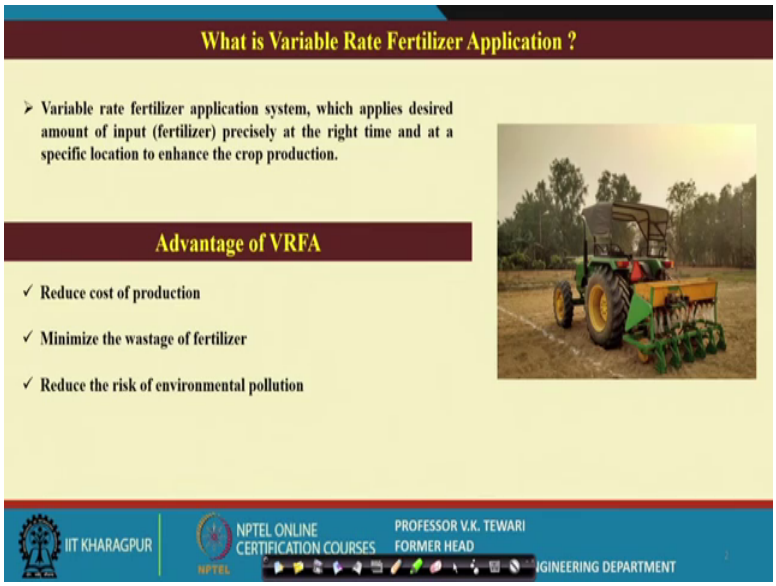

What is the variable rate fertilizer application system? We desire see we would like to know at a particular as I said at a particular location in the field, what is the amount of nitrogen there and how much should be applied for the crop. Because it may happen that if you have large amount of already available and you put certain amount, then excess of anything is bad. So, you will find that if it is that their amount then there will be a problem.

Now advantages is, it reduce the cost of production definitely, the input cost minimize the wastage of fertilizer unnecessary and reduce the risk of environmental pollution yes and on both counts the environment of the soil also will be hampered. So, these are the benefits of the variable rate fertilizer application. We would like to apply very fertilizer at varying rates in the different locations in the and the field.

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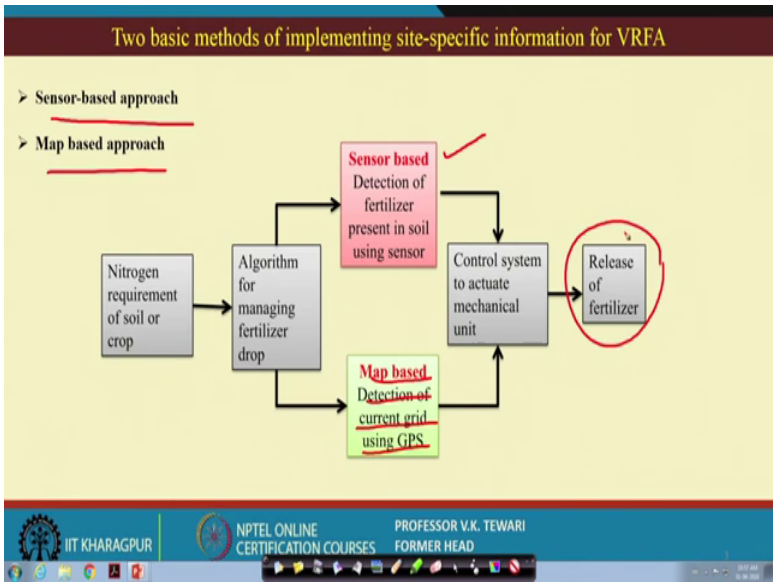

Two basic methods of implementing site specific inform information for VRFA. In fact, there are two basic methods of implementing this. See what we want to know how what is the level available at present and how much we should give, this is what we want to know. How based we can know? One is that we have a sensor take the sensor and then go in the field and wherever the sensor tells us that, the value is less than a particular value we will record and then apply immediately on there that this is on the go or you can say that sensor based approach.

Now another one is map based approach; that means, we map the whole field and find out how what is the location of the of that field with respect to the other look other parts and then what is the content of the nutrients at various locations in that field. this is we create a map of that and on the basis of the map if we take the map and then use with the power advanced technology of MATLAB and other software's through which we will be in a position to store this information.

And then when we go at that location, the sensor will identify that this is the location where this much is to be applied and accordingly we can apply. So, this the map based approach we have two items; the sensor based approach and map based approach. Nitrogen requirement of the soil we know, algorithm for managing the fertilizer drop, sensor based approach, detection of fertilizer present in the soil using sensors and map

based approaches as I said, detection of the current grid using GPS and then of course, release of fertilizer for both the system.

So, this is a system by which we you either take this or this, but let, but sensor base approach is still people are applying or trying in the world and we have not got any on the lagoons sensor based approach for doing this. But most of the people have done mat based approach and this map base mostly is that the difficulty is that you need to create map for all the locations wherever you there.

But there are other aspects whether you should when you should create? Whether you should carry create it after each and every crop or whether you should have a 3 year period and whether you should have a how much number of samples you should take and things like that, if you want to create a map based approach.

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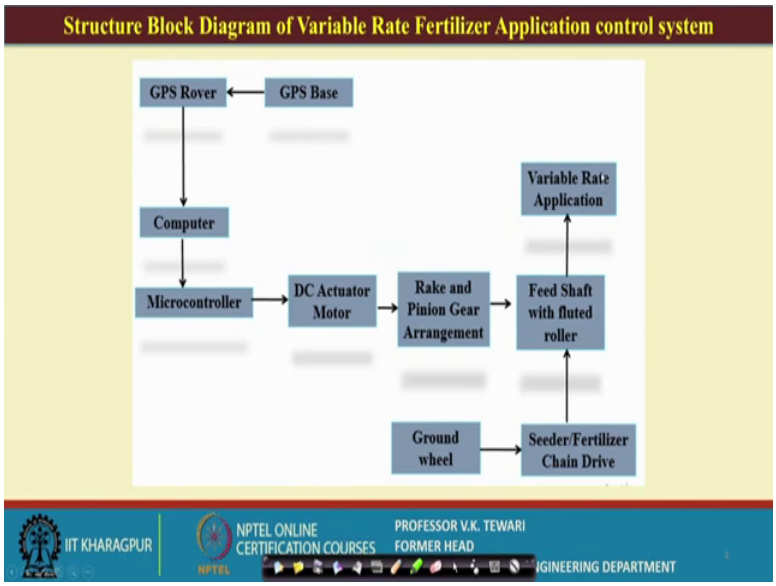

Structure of the block; now what will happen? You have a GPS, the GPS base, you can have that a computer will be there, then microcontroller then the DC motor, a rake and pinion arrangement, then they feed shaft with their variable rate application, then you can have the chain and chain drive and then the ground wheel. So, from the ground wheel you will get here and then the information will be there for variable application of the seed.

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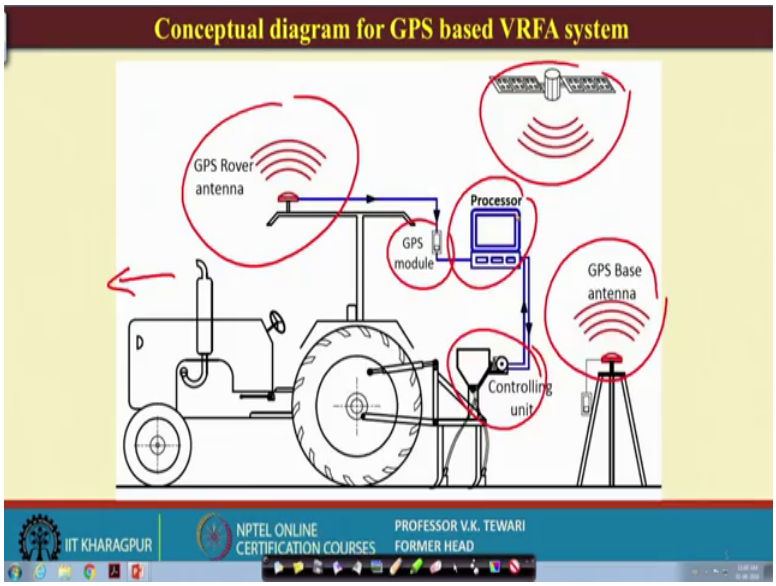

Now, this is the conceptual diagram of a GPS based system here, you can see. This is the GPS rover here then this is the satellite here information the GPS antenna base which will be there outside and then the processor, the GPS module in this and then here is the controlling unit and this is the location which we are going to apply.

So, the tractor movement is taking place in this direction. So, the conceptually this that we get information connecting these with the GPS, which is there on the tractor itself, then the base antenna is there and GPS base antenna is there and the processor is there, where we stored the information and then when we tractor goes to that particular grid or the location it identifies and goes back to the processor and tells and accordingly this controlling unit will do the job.

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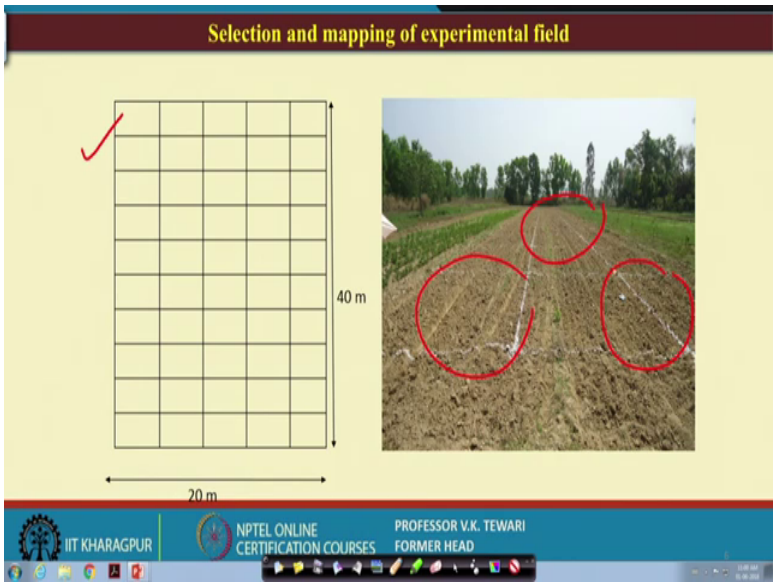

Well, selection mapping of experimental field; you should say for example, 20 by 40 meter field has been chosen here. And you can see the grids which have been made here; you can if you can see the grids, which are made here and this. So, we are in a position to map this field. So, whole this is the process by which you should do we have done it at IIT, Kharagpur and that is why we want to show you this information and for your knowledge and which you can add and do something better.

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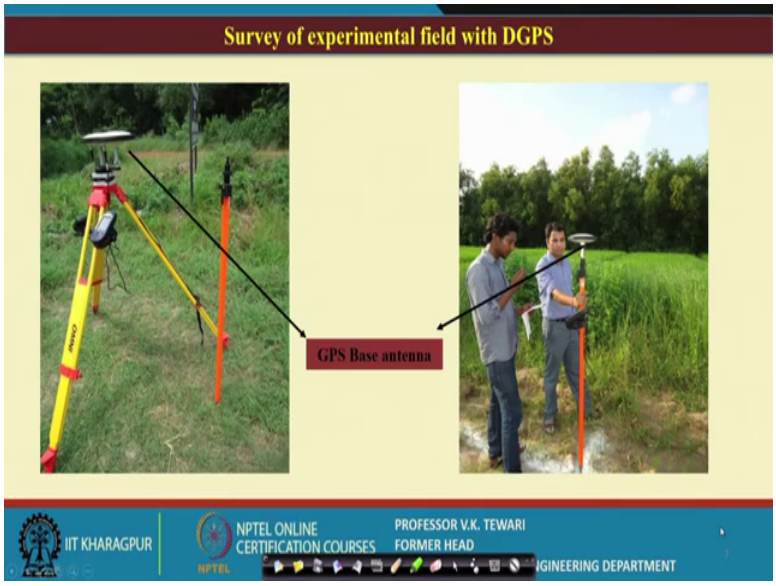

Well, sad way of the experimental field will DGPS; Differential GPS, you can see that we will survey. This is the one which is there at the base and then antenna and we can go to different locations and survey the field. Well this is very important to know what are the locations and what is where at this position we must have. So, the survey of the experimental field within DGPS that we do.

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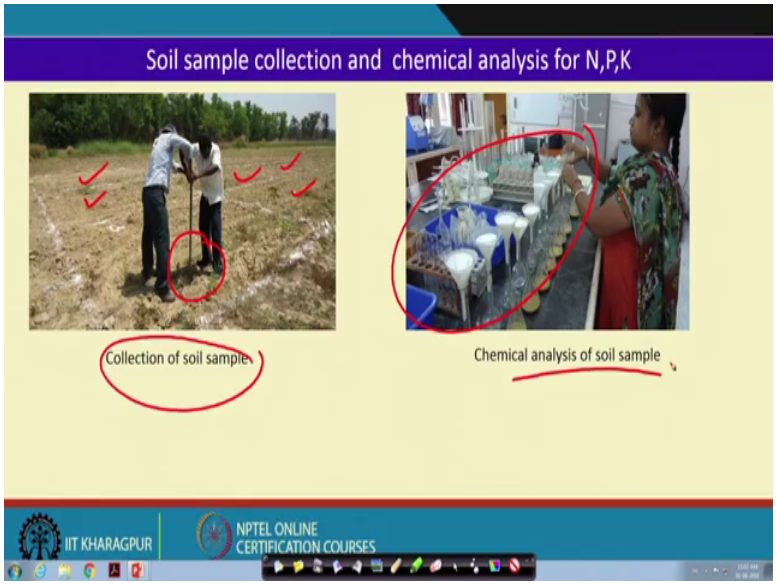

Well, soil sampling; see when we collection of soil simple. In fact, see collection of soil sample; the soil sample collection is very important. From each of the grids, you can see that these are the grids these are the grids over here. So, how many samples we should take as I showed you the field? So, in the field itself we should have different grids and out of the grids the you should take optimum number of samples.

Maybe in a grid of say 5 meter by 5 meter or 2 meter by 2 meter, you can take from the centre and from the sides or the corners you can take or if it is a bigger one then you can take accordingly. Now, this depends on the designer, on your on your ingenuity, on your own experience etcetera and then this samples have to be taken to the laboratory and you can see that this is a very tedious task. But we need to do it for having the map, because until unless you do this in the laboratory at large scale basis you will not have an information.

And as a designer you must have such studies done for different locations to get a projected idea about a larger field; this is very important.

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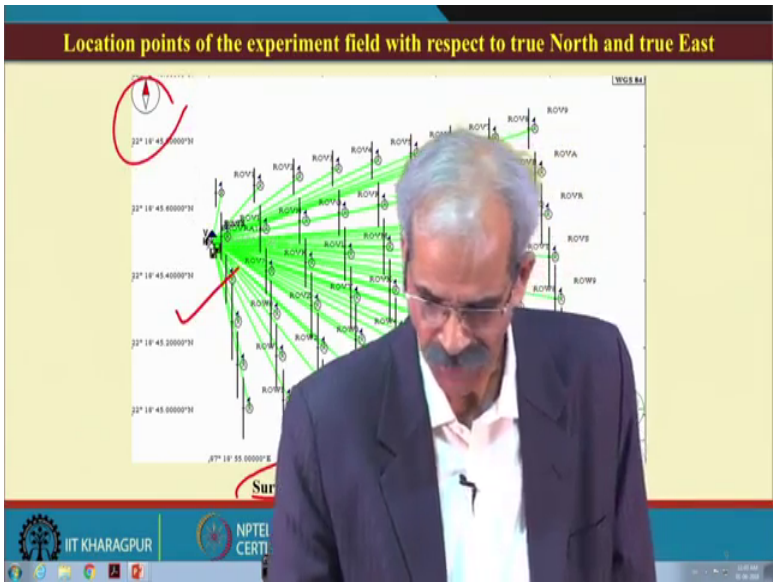

Well, locations points experimental field with respect to true north and true east well. This talks up the survey points of latitude and longitude of the location here. Now this is the one which we did at IIT, Kharagpur that information is over given over here, how is the rover when it is going to different locations what are the latitude and longitude at that place; it is important because this information has to be feed to the computer and the software, we will read this at the point when the tractor moves and goes to that particular location. So, it is very important to have this survey points latitude and longitude of that location this is the one which we have done at Kharagpur.

And accordingly this has been created you need to create this for your requirement and these are basics information which must be done.

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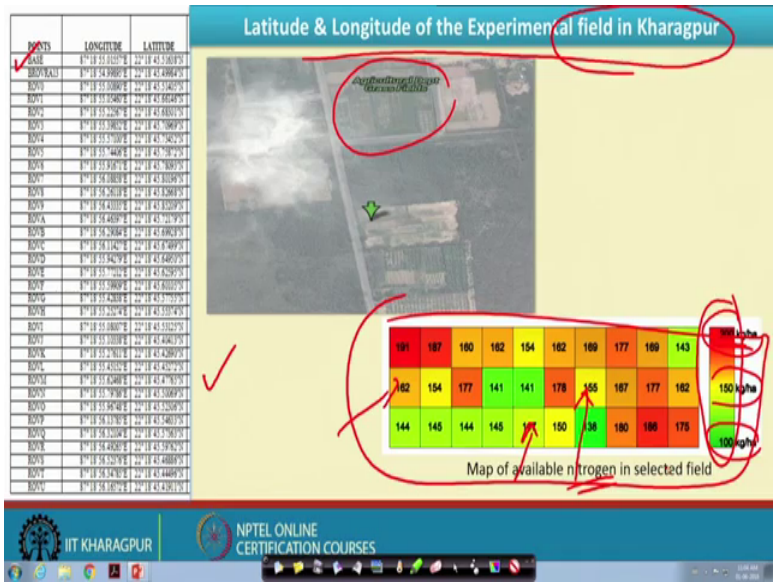

Well, on the same basis I can just tell you that see the latitude longitude of experimental field at IIT, Kharagpur. This is the location where we have and these are the all details of that points which have been surveyed here. Now, this is the one which is available nitrogen selected field we can have. In fact, we have developed for potassium and phosphorus I mean P and K as well; that means phosphorus P and P also, but for nitrogen only I have shown you here that we have developed this particular source that when you have this colour they were 200 kg of per hectare is available for 150 kg and 100 kg.

Now, this is the field, now in the different grids that we can these are the different grids and at those different grids this is the availability of nitrogen, available of nitrogen in the selected field. This is one example of how do we do it, when we take the information of GPS, differential DGPS, take the soil samples the number of soil samples then take them into the laboratory and find out the NPK etcetera. So, we have created the maps of NPK all, but I am showing you only a map of N.

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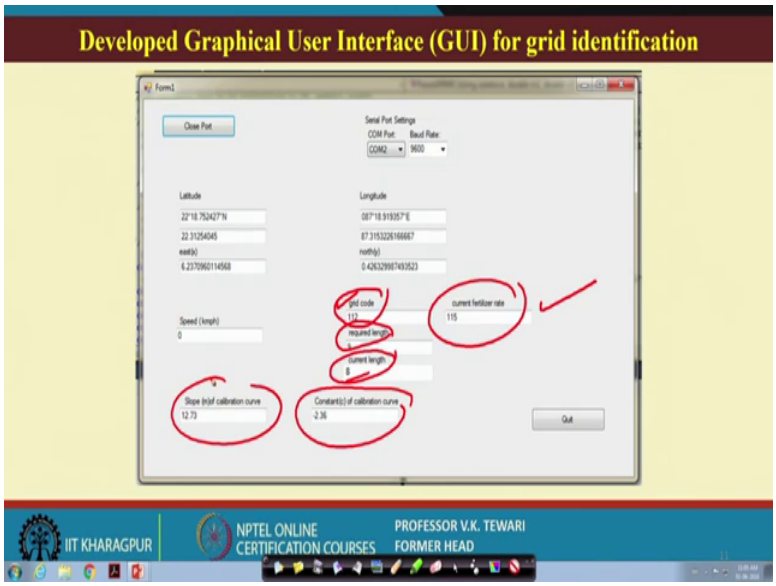

Well, we have also created a graph graphical user interface for grid identification, this is very important. Well I am not giving you all details of this part because these are all part of the IPR and all that, but these people have this is very simple one which they students have developed, our students we have developed here and it is in a position to tell us as to see what is the current fertilizer rate at a particular grid code say here. Then the required is this, then the current length is this.

Now this is this will talk of how much is the exposure that has to be given. So, you can see here that when it goes to a particular spot, it will tell us the current location is this and then at a particular grid and this is the exposure length, this is exposure length we need to; that means, you need to explain here. So, this shows that calibration curve here, I mean the slope of the calibration curve all details which shows us in this grid. Now this talks of the Quit disco. It as a very simple one, this very effective one for the designer, which we have developed.

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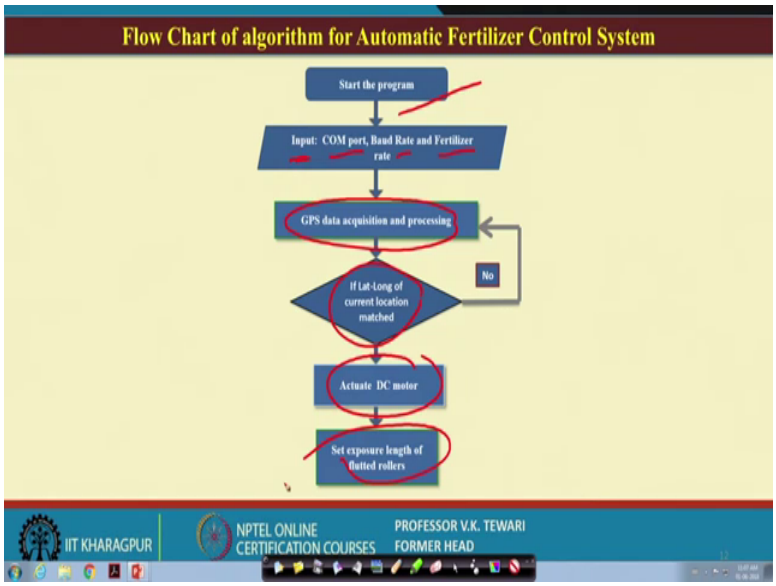

This is the flow chart of the algorithm for automatic fertilizer at the flow chart well. It is what giving the flow chart to you can have an idea about this. See this start of the program starts here. What inputs it takes the inputs are in the comport, baud rate and fertilizer rate. Certain these are important inputs when you go into details of the electrons part, you will understand what they are, but this system we have developed at IIT, Kharagpur and that GPS data equations and processing the GPS data, which we have I have shown you earlier of latitude and longitude that information.

Then if let you longitude of a current location is matching. So, there are certain aspects which we will talk of whether it is matching or not depending upon the requirement at particular ways. Then the DC motor will actuate and set exposure length as I showed you in the GUI which was shown earlier, this is the flow chart for that.

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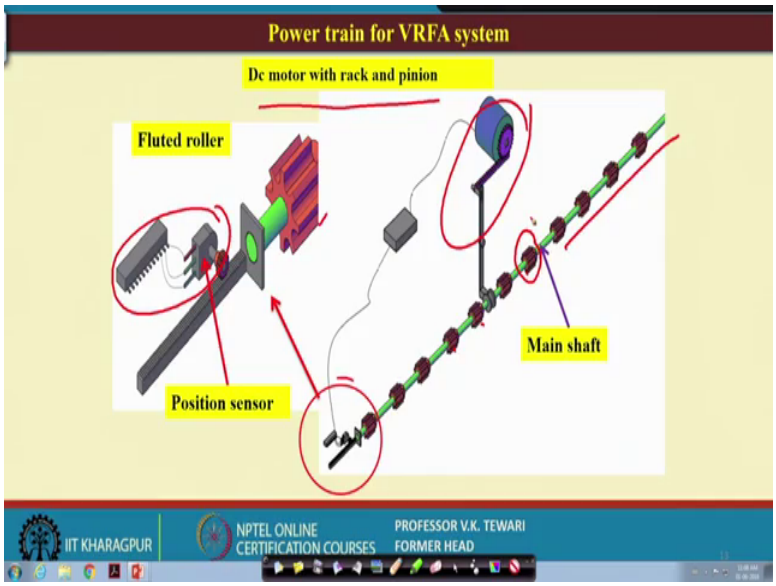

Power train for VRFA system, well, this is a power train now we know that this is the metering shaft here and then these are the locations where how we are in a position to operate this. These are these individual flutes which are there and then this portion has been large here. You can see the position sensor, there is a position sensor which is connected over here and then this will operate at this location so that the fluted roll can be adjusted. This shows the DC motor with rack and pinion arrangement.

So, it will this is the power train of the variable red fertilizer applicator system which is there. This talks of the one which is existing and if you want to design and have a change in these, it depends on you can think of a new system whatever for fertilizer, or for seed etcetera. You can think of that this is system which we have created and want to let you know.

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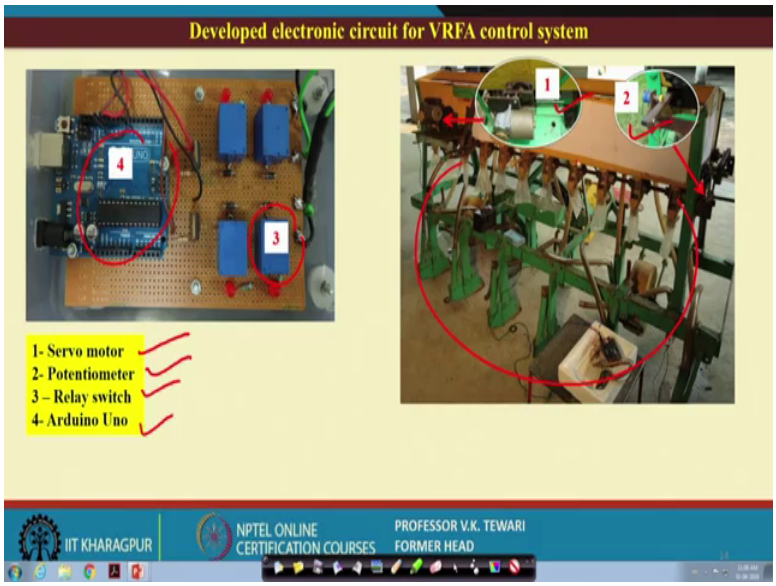

Well developed electronic circuit we can show that here the just the Servo motor, the Potentiometer, Relay switch and Arduino Uno all these are shown over here; 1 is the servo motor here, 2 is the potentiometer in this case, the 3 here is a relay switch and 4th is the Arduino Uno. So, we are in a position to show you and this is the unit which has been developed in the field and in fact, we have operated and this has given us a result which is very close to our acceptability.

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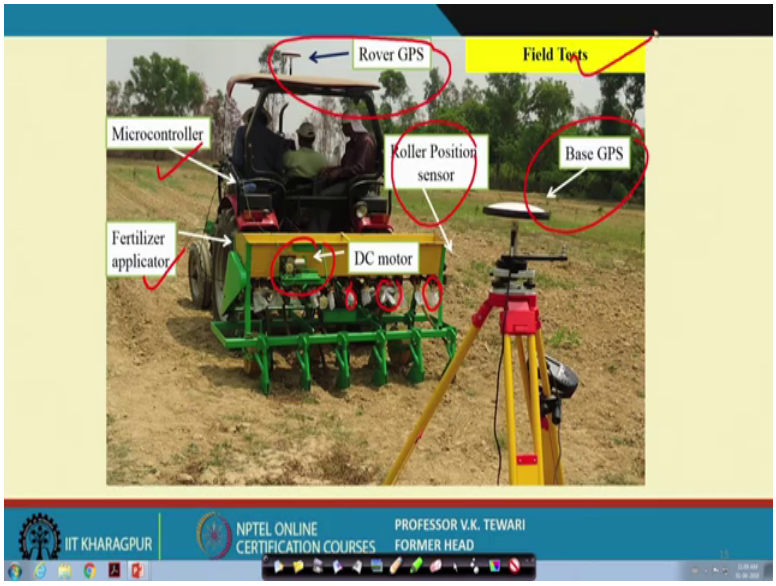

Well, field test we have done field test of this let me have a look at this. The micro controller, the micro controller is here, the fertilizer applicator is here. Then these the DC motor at this location and the roller position sensor roller position sensor ok, then base GPS is here, rover GPS is in this place.

Now, then we are in a position to see in the field, this has been in fact, we have also operated this in the field and we have measured this is for experiments. So, we have just put polythene in order to know that, what is the amount which is falling when the system is working in the field. So, it is a field test which we have done at this place to see whether our system has worked or not. So, this is one innovation that we have done at IIT, Kharagpur and which is compared to anywhere world in fact, system and which is working.

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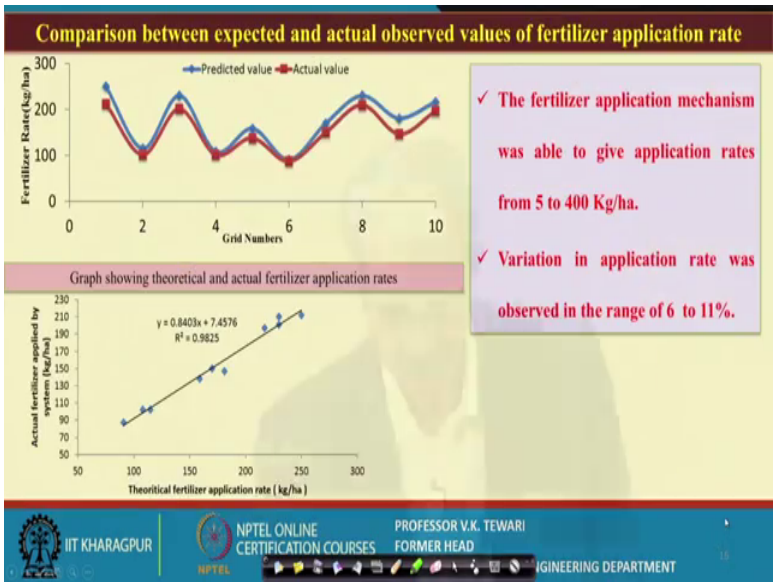

Well when we compare this with the output the results of these two we find that we are not very much off, the fertilizer application system we find that we are in a position to give application rates between these two vary as low as 5 to about 400 kg; that means, for a smaller seeds also we can do and as high as high application rate and the variation in the application rate is not very much, it is very small.

You can see the graph itself you can see the predicted and actual graph itself which will give you a good idea about this and the actual fertilizer application and the theoretical

fail. So, you get a very good R square value of this which says that the system has worked well and there is a promise for this.

Thank you very much.