Farm Machinery
Prof. V. K. Tewari
Department of Agricultural and Food Engineering
Indian Institute of Technology, Kharagpur

Lecture - 39
Manually Operated Knapsack-Cum-boom Sprayer

Welcome students, to my lecture number 39 here. We have discussed about these sprayers and the dusters and the nozzles atomizers and the various aspects earlier. Now here I would like to say and show to you that what we have designed at IIT Kharagpur particularly from the knapsack type's sprayers.

You have seen that the knap knapsack type sprayer, which are carried at the back, may be manually operated lever or it could be a small battery operated system motor. Where it can spray the liquid and all that and type of nozzle which is used. We wanted to see if we can increase the output of the person here, he what he has to do, is he has to carry the chemical about 15 liter for some may at least 1 hour or so till the whole chemical is removed.

So, even if 1 liter is carrying and moving inside this and the plant. So, we thought why not utilize the power of the man, in a different form instead of carrying and then operating by one hand it is very start arduous. And may be in earlier I have in my lectures I have said that the constitution about human being or the operator is very important. And that is why you cannot have a device which does not match the require capabilities of the man.

So, in order to have this system, which matches the capability as well as which enhances the output of that man. So, we wanted to virtually transform a manually operated natural sprayer into a boom sprayer. And which can be simply carried inside the rows of the plants and then sprayer a spraying could be done. And we have slightly by ambitious project we took and I will show you what we have achieved so far.

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See men will operated one as I said here the sprayers are regulation is it means is not there. Therefore, accurate and pesticide applications are difficult to manage this what is written some. Some sort of a justification is given for this, but then justification is very simple ah. In fact, when you talk of these it is definitely difficult and arduous are not comfortable for the person to carry 15 liter and then keep one operating and then moving. Not only that he keeps on operating by one left hand and maybe by right hand is moving the nozzle.

So, that a particular swath is covered and then he moves forward. It is very strenuous task, if the same person is given a device which can be imposed inside or may be pulled in the in the whole plant area and a spreads onto that. So, we just employed this for that we need to do certain changes in the design because here the person is utilizing his hand left or right whatever depending upon whether it left lefty person and right [Laughter] hand person he will do it. So, we have utilized three point linkage, which is the crux of this particular design.

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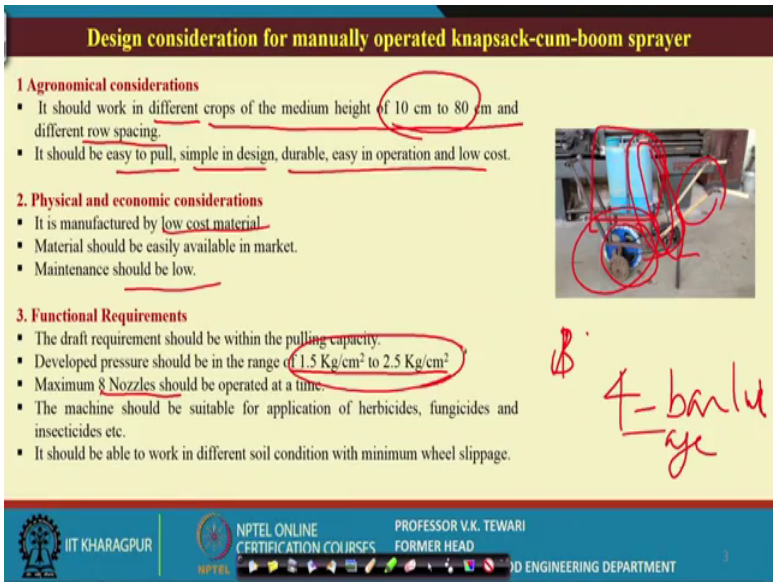

What are the design considerations? Well you can see here the different crops medium height I mean height of the crops should 10 to 80 centimeter. It varies depending on the crop and different row spacing. Now these are some of the agronomical requirements for a particular crop. Now it should be easy to pulled simple in design durable easy. These are the certain things which your one would like to have. That agronomic from agronomical point of view it must fit in the row to row spacing and then the height of the plant so your designs will be said that you above the plant you are in a position to agree.

Then physical and economic considerations so it should be low cost material value these are all they minimum requirements that we think and maintenance should be low fine. Now functional requirements what is this is very important we have in fact, you have seen that we have operated hand operated which we call lever operated most sprayer locum so knapsack type. Now the developed pressure should be in the range of this because this is the one which we had about 1.1 to 1.5 kg per centimeter square is the pressure which we maintain in the knapsack type.

So, we have to maintain that much pressure and the nozzles which we have taken is 8 nozzles in fact, as I told you that we are slightly ambitious and we wanted to have 8 nozzles spread boom, and that boom can be pulled. Once you were in a position to walk inside a crop I think with the same power of the band we can do 8 times the worth, this is

what we thought. And we have been in a position to do this. But how do we achieve this part, this is one thing which is very important.

So, what we did is that we have here used here see instead of the when the rotary action; the rotary action which is available from this rotor here has been converted into the reciprocating action. And there for that we have used 0.3 not. The we had used linkage arrangement I mean 4.4 bar linkage mechanisms. So, just a second 4 bar linkage mechanism this has been used. So, 4 bar linkage mechanism has been as used here and the rotary power which we have got from the operation and converted into the reciprocating motion of that which is in the done by the hand.

So, you must say here that it will depend on the speed at which the person moves. Sure it will depend on that, but then the pump remains same. So, we have used the same you can see here that the tank which is here with the same tank which the person uses for his knapsack type. So, same pump has been used, what has been done is? The only the operation, which the man was doing by carrying it is being carried on a small frame which is made here and then we have a handle here. So, the handle can be adjusted and the person can push this inside wherever he wants. And the rotary motion is converted into reciprocating motion of the movement of the lever. And we are maintaining a pressure between this to this. So, by using the 4 bar linkage mechanism the, this has been achieved.

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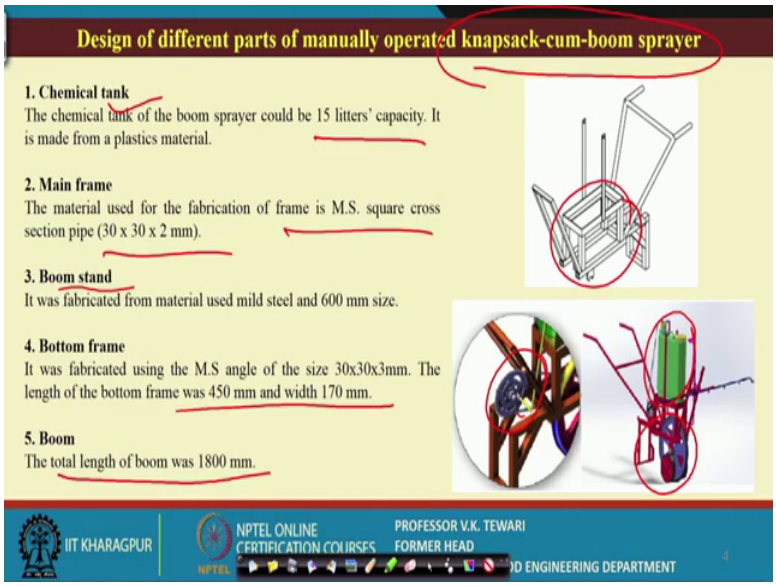

So, the different parts now, these are some of the details of the one which we have done here you can you can see here. The chemical tank about a 15 liters capacity of course, as I said that this is the one which is available already. So, we do not have to do anything. Then the main frame, frame has been created so that the frame as we so that we can keep the tank over there and then this tank can be transported. So, for transportation of that tank we have the wheel over here. So, the boom stand for creating the boom because now this boom should be maybe if you are talking of 8 nozzles.

So, there is a spacing of the nozzles and then it is not good to carry that weight. So, we have made it in such a way that it can be folded or maybe in this frame. So, that it becomes in the same frame and it can be taken inside and once you go inside the field you can spread it over. So, the frame has is has been created and the boom length total boom length is about 800 millimeter. So, this length is worth to cover that much of swath and in the earlier case swath was not possible you have only 1 nozzle and the swath is not more than about 40, 50 centimeters or so 400 millimeters

At the same time the person has to have all this thing carried on him. So, this is the beauty of this particular device or what we are calling is knapsack cum boom sprayer which we have developed at IIT Kharagpur. And it is what is showing you this is good for small fields and good for a small farmers and also a cheaper device. Now you can see a here the never a sprocket, which is shown for with which we have made the rotary arrangement and converted to reciprocating arrangement which has been shown.

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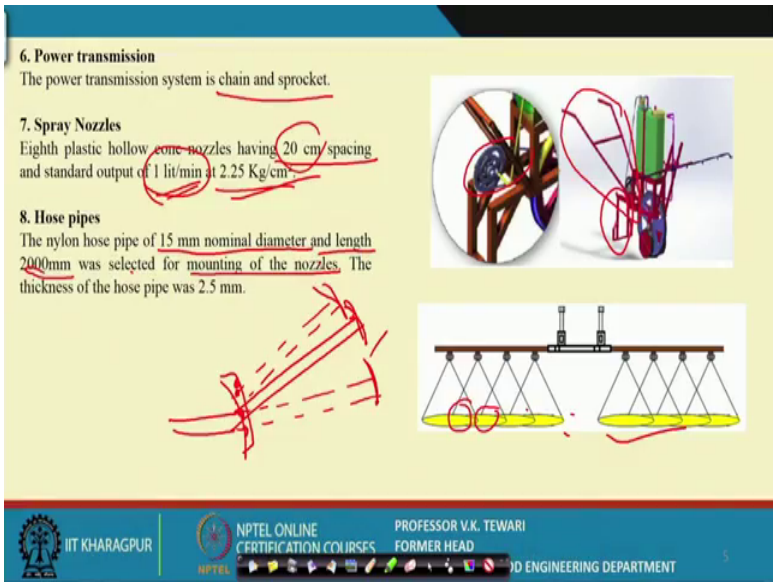

Well you can see here the power transmission they spray nozzle the host pipes some more details are given here. The power transmission the power transmission system is chain and sprocket. Yes, while it is said that this chain is sprocket no arrangement is there. We have to think of how this chain sprocket arrangement can be made constant can be utilized for giving a constant pressure and constant rotation of movement of the lever because this believer when the person is operating with the hand the similar aspect similar effect has to be there in this case also.

And we have my been in a position to attempt there is a small stand also we have made. So, that it where it is there it can stand all that since it is only one wheel that arrangement has been made. Then these particular handle see this handle has been designed argonomically. So, that if an persons of different heights can be can be can be incorporated because you the you will hold the handle here. So, you have to know what is the height of the person, what changes if a tall person is there if a shorter person is there so accordingly there has to be change in the inclination of this handle.

So, the handles this handle can be changed. May be that if I show you here, this is one location it could be another location could be something like this may be another location could be this. So, depending upon the requirement these things can be changed these can be changed the handle can be changed here handle can be change here. This is another thing which has been incorporated in this.

So, from argonomics and from human consideration point of view we have considered several things one is that we have reduced the fatigue or reduced the total load on the man which was carried on the back, second the person does not have to operate this and both the hands.

So, you can see how much strenuousities on the task we have removed that. And while in a standing posture he can just push the liquid push the tank which is there on a frame. And it is easier to push that through the system because there is a field which is there So, once it is on a wheel it is easier to push and the system will work.

Because power we have taken the spray nozzle this the see it spacing is 20 centimeter and the spray nozzles are put at 20centimeter apart. These output we are getting is this at a pressure of 2.25 kg per centimeter square. So, this has been are tested in fact, and we have found that the pressure. Well you may height might have certain questions we have given an overlap of about 30 percent or so as you can see from here certain percent of overlap is given here.

Well there could be questions as to what is the affectivity of this? We are testing this and we have found very encouraging results, as you can see here that you are getting 1. 1 liter per meter at 2.25 kg per centimeter square a slightly higher pressure. But then we are in a position to get this pressure. We can get this pressure at 20 centimeter spacing. So, and host pipes are used 15 meter diameter length and length is 2000 millimeter Selected for mounting of the nozzle. So, well these are details of so how do you select this nozzles how to keep it.

In fact, initial hiccups could be there when you are this is the first prototype which has been in fact; it is laboratory prototype which we can say. So, the we are working into more details of making it is a field prototype machine. And so that we can rigorous test it to under the actual field conditions in different crops and then gets there. So, so preliminary information which we have we will like to show you.

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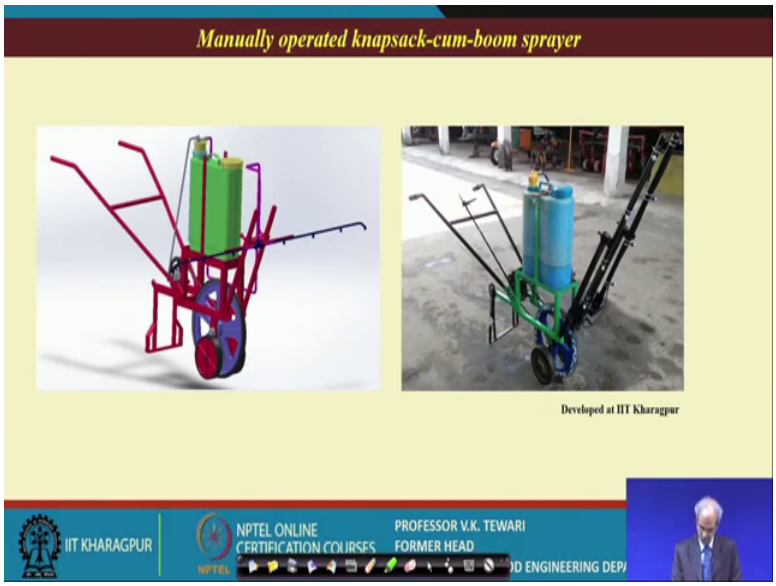

Well this is what it is you can have a look at this that this is one diagram, which is given for the autocad diagram and this is the actual unit here. Now, if I show you here laboratory test you can see you have a look at this that the person is simply pushing this you can see and from all the all the four here and all the four on this side there is a discharge taking place. You may question that this discharge is reducing as it goes on that side? Yes, we have we have tested this and we are trying to optimize the one's. Now you can see that how much of area see about 1800 mm, it is about 101.8 meter swath you can cover and it is very easy for the person to cover this thing.

You can have a look at the second, so this is what the system which works in the laboratory model or laboratory. You can say yes laboratory fabricated device which needs to be tested rigorously under laboratory as well as under this with the different nozzles. We have used a actually fan both the several nozzles have been used in this case ah. You will see depending upon there is a solid cone or hollow cone or fan spray nozzles various things are there. But then each a nozzle each thing needs to be tested.

And the if these need to be tested so various things are required. For example, we need to test with the different types of nozzles; different spacing's of the nozzles, and then the pressures what we are getting, and what is the speed at which we are getting that pressure. Because and that will help us in operation of this because the same tank you can see the same tank has been used. So, a you can say a slightly innovation for a small

device small plots it can be used you the height can be elevated depending upon at what stage of the crop you are applying so this can be lifted.

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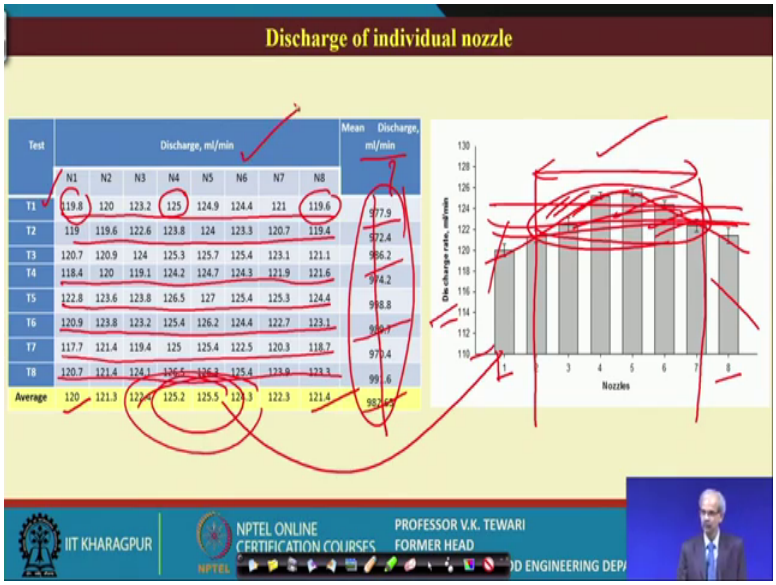

So, some of the details of this actually, what are the details of this particular device and how much is the discharge that we get? We had tested under various conditions. Well as I told you that maybe that from each nozzle if we if you want a particular nozzle tested, then you will find the here just have a look at this that the nozzles are (Refer Time: 17:04) from 1 to 8 all the nozzles.

Now, he you can see here that the discharge which we are getting here the discharge is something like this. So, that mean then we are not getting uniform discharge. So, our claim that we have virtually replaced what we are doing its not fully acceptable to the extent that. Well this was there was only 1 nozzle here there are 8 nozzles, but then if you maybe if you can check up maybe somewhere this you can say that this area could be said to be covered.

So, maybe you can say here that this is the length that you are in a position to cover you may not be in a position to cover say one here one here gone. So, effectively you can say it in a very comfortably that this is the area which can be covered with the discharge which we have got. Now other thing which has not been mentioned here I would like to tell you is the speed at which the person moves, now there are certain problems when the person is there in the field depending upon which crop. If you are talking of wider row

crops if you are talking of orchard crops where the these are at certain distance, then it is easier for the person to carry this..

But if you are talking of cereal crops where the it is very difficult then you have to consider, what stage it is there? And how much is the spacing between that crop? or maybe that we have to we have to shorten the distance between the row to distance between the two wheels the two transport wheels which are there and connected the four bar linkage mechanism for designing the lift the operation of the lever.

So, this we need to look into these design and by the crop to which crop we are talking for. So, there are certain aspects which need to be done. So, if we go back to the discharge values. So, mean discharge now we see here then there are various tests we did. So, you just have a look at these tests well there is not a single maintain mention of the speed at which it is mean. But if you say the speed of operation about say 1.5 to 2 kilometer per hour.

So, depending upon 1.52 kilometer per hour then this information needs to be further investigated as to how much. Now let us have a look at this data see a test one what we are getting is see from nozzle 1 to nozzle 8 the variation is this. So, the variation is from the lowest you can see is about 119 and the highest is about 125. So, this is what you get the forth one you get 125, but this is not so.

The last two roughly you can say as it is very clear from here that they are not getting. So, maybe that if you can increase the pressure possibly you will get uniform, we are thinking that if you have maybe the speed can be increased or the mechanism which has been developed if that mechanism can be made efficient and made more robust then we are in a position to get high discharge and at the same time high pressure.

So, slightly higher pressure may be that this will be a flatter one here and then we will be able to cover this. And the moment we can cover this you have increase the capacity of the man same person with a one knapsack type he is able to do this. And the same person when he different device is given he will be able to do this much. They you can see another test.

So, more or less each of the tests you can see this is the variation here this is and say another one this is a variation here. Each of these from 122.8, 122.4 now mean values

then have t 6 this is t 7 is these are all, but mind you these are all tests which are which are at laboratory level we are not talking of the field level at this point of time.

So, the average that you get from n 1 is about 120 and this is about 121 or so. And roughly you can get in the centers those is what I wanted to show you here. So, the mean discharge from each one of this milliliter per minute you can get is these values which we have got. So, although it appears that from each of the tests mean discharge milliliter you get (Refer Time: 21:50). So, I think these needs to be looked into for how many such he has got this thing we may cancel this. We can this is the discharge which we can think of

So, the preliminary testing of this beauty of this device side I can again emphasize is that, we are employing the same person and increasing his capacity. By the knowledge that you have about 4-bar linkage mechanism which can be used for converting the rotary power to a reciprocating one and get this thing done. So, more and more testing of this unit is required under field conditions, before we can say that yes this machine is.

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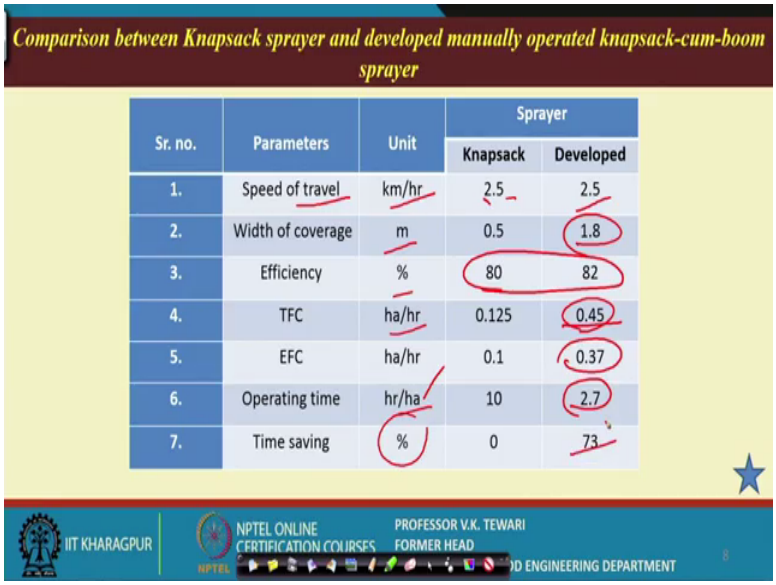

The comparison between knapsack sprayer and develop manually operating knapsack cum boom. Now what is the comparison? Well it is worth comparing here because as I said that the one in the knapsack type here the agronomic considerations. No agronomic consideration has been thought of here, but then that is the first consideration which has to be done. The person if the person is very comfortable in this operation, the person is

not comfortable in that operation, but because is all both the hands are brave in action he is walking he is carrying that load so there is hardly any comparison. So, far as the comfort and safety of the person is concerned.

So, apart from that if you compare the other part of it definitely we should be getting because the speed you can see that see the unit kilometer per hour this is the speed of travel. Now speed of travel is about 2.5 and 2.5, if we find out the same speed I wonder whether we can achieve 2.5 or not or maybe 3 in the depending upon the type of the and condition of the crop if the crop is at a tender stage, maybe 3 weeks, 4 weeks or so it is possible. But when the crop has gone more than 6 weeks, 8 weeks and there we need to spray for currently control of pesticide in six bits maybe throughout then it is ok.

Now here the drawback one you can think of is that since the we are spreading everywhere. So, we cannot control it has it will come out at all locations or we might have to plug these nozzles wherever we do not require. And it can used cannot be used that way we have to think of how it can be used for a spot location.

So, in a spot if you require how do we do this part. So, that is one thing which is still a question mark for this particular device and width of width of coverage meter here the meter of coverage is high. Yes, so we have a high width of coverage the efficiency is better of course. Efficiency in both the systems are more or less same. Hectare per hour hectare per hour you can see you get a very high one. Then here 0.37 then operating time well 2.7 hour for say per hectare this is very good.

And time saving what do you do in this time saving in fact, is that 73 percent of the time is save. Yes you saved even 3 percent out of time. And what is not mentioned as I said is definitely the agronomic considerations which move on the designer must think for such devices. And it will be a unit which is very good for small plots and a small area and the cost is also not very high. Yes you will need to add the cost of the nozzles you are the other setup which has been given. This cost will be addition to the cost of the device you will have to purchase the tank which is there and use this.

So, slightly cost would be higher, but then you can have a tradeoff between the total output and this. So, if we consider these I think this is a promising device which will be tested which is being tested IIT Kharagpur. And we will be in a position to come out with

a much better unit field unit in future. Thank you very much for this and if you have any other questions and then queries, we are most welcome.

Thank you.