Farm Machinery
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Lecture – 33
Performance of Weeding Blades of a Push-Pull Weeder

Well students, welcome to my lecture number 33. Here, I would like to tell you about, the performance of a weeding blade of different types of Weeding Blades of a Push Pull Weeder. Now, you know that in the previous lecture, I discussed about that what are these push-pull Weeders and in fact, these devices which are manually operated we need we cannot keep pushing or we have to push and pull, this way we are in a position to conserve energy and we are in a position to do the work faster.

So, these push pull weeders are widely used. Now, we will see how we measure the performance? What are the, various attributes to measure this performance? What is the mechanics behind working with these tools? Let us have a look at this through this particular lecture.

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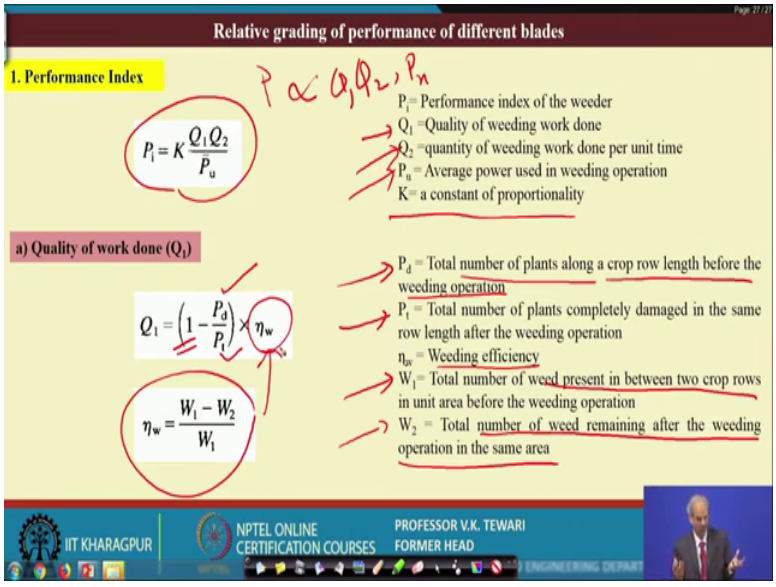

See, the relative grading of performance of different blades. Now, what is the cutting element? In fact, if you recall in the previous lecture which I have said that the cutting elements are different types of cutting elements which are employed. There is a wheel in

front and the wheel is for maintaining the depth of operation and for forward movement and you have a handled on the which the person is applying the force.

So, the performance is on what? We will see the performance of that device on the basis of what is the quality of work it has done? How much is the quantity of work that it has done? And what is the power that it has consumed. So, on the basis of the quantity of work and the power consumed we will try to judge it is performance and that is how we have defined the performance of this particular device as, this is, this here. Where, Q 1 is the, quality of weeding work then, Q 2 talks of the quantity of weeding work and that P u is the average, power used and K is the, constant proportion proportionality because this performance is proportional to because the performance P is definitely proportional to Q 1 and Q 2 and, the power used.

So, on the basis of this if we and we can find out these we will be in a position to, find the performance of this blades. Now, how do you find the quality of work done? This is very important because this quality of work done has certain attributes in this. See, this P d and P t you see, you know the total number of plants, along the crop row length before the weeding operations you we know that what are these. These are we are talking with respect to how many plants are there in a particular row? So, we have the number of plants.

Now, as I told you how they are how the weeding operation is measured that I talked of the quadrant with whether it is 1 by 1 quadrant 1 meter by 1 meter or 0.5 meter by 0.5 meter quadrant. So, that quadrant is the one which tells us how much of weed is already there and what is the weed which is going to be removed from there after the device has been, operated in the field. So, here this P d will talk of the total number of plants along the crop row and the other one we will talk of the total number of plants completely damaged.

Now, this damage, I must tell you at this point that, this damage could be superficial damage, wherein they it will appear that the plant, has got cut here and there, but it later period of time it may recuperate and it may not, lead into yield loss and that is called the superficial damage. Now, one is yield critical damage, where it is cut in such a way or maybe completely the plant is cut. So, they are that damage will be called as yield critical damage.

So, the depending upon we will talk of only the yield critical damage, not the superficial damage because superficial damage is as weeder saying that is not damage, because this will be, fortune later on it will revive and the plant will grow over a period of time. So, then we need to know these 2 P d and P t over here. So, once we know, P d and P t and of course, 1 minus that where we do not want that see P t minus P d; that means, there should not this should be divide by d. So, 1 minus this will give us, what is the quality of work done.

Now, this quality with respect to the efficiency now, this is the weeding efficiency as I told you that how much was there and, how many weeds were there before and how many weeds are left after the operation. So, the ratio of this you can see the weeds total number of weeds present in the two row crops and then, the total number of weeds in remaining after the row operation in the same area.

So, if you have these then using this you were metro going to get a total quality of work done. Now, we want this to be more this quality of work done to be more. So, more or good quality of work done per unit of power is what the performance we are talking with respect to a particular blade which is used. So, we are in the here we are only talking in a push pull type of weeder what are the different blades which are employed and which blade is better. We would like to see this, and what is the mechanics behind this operation.

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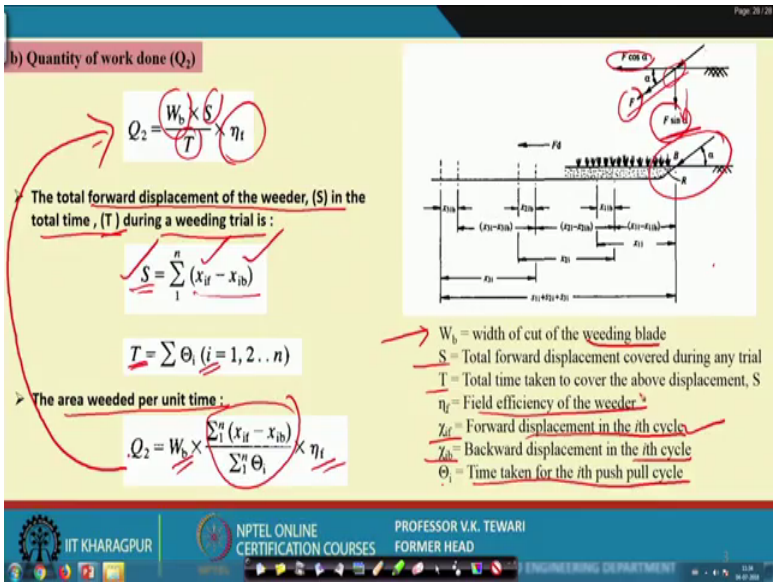

See, it is worth knowing the operation you have seen that, the push pull type of device is that, we are pushing some distance and then putting it back, not exactly the same distance, but little distance and then again. So, push and pull now, how it happens you can see that, if we consider several cycles of such push and pull then, you will get ayou can say is, a stage like this, which I have created here. You can see that this is what you will have you can say that initially this is the location where the your blade is working and the person will be now, this is the position on the blade here.

When you operate push and pull it will have there will be force which will be acting here this force F. Now, this force is at a certain angle alpha. So, this P cos alpha F cos alpha will be acting in the forward direction and F sin alpha will be acting in the backward, in the, directly below. So, what happens is the a horizontal direction and this is the vertical direction particularly downwards.

Now, here this will help us in increasing depth because then, we need to cuts, these weeds are cut not exactly about 5 or 6 inches, but about 2 to 2 and a half or 3 inches or so only they are cut. So, for that this force is responsibility F sin alpha and F cos alpha talks of giving momentum in the forward direction the wheel is there. So, wheel helps us in giving the momentum forward direction as well as mentoring the were depth because if the wheel is not there then the depth will be varying and it would be difficult for the human being to operate and that is why wheel has this versions of because it gives (Refer Time: 07:30) omega a square where it will give forward motion, energy for forward motion as well mentoring the depth.

And then, this short cycles of a push and pull wheel give us the total speed at which because, it is not possible to measure the speed here just like, measuring the total distance in particular time because the action is slightly different. So, what we have done is we have broken this into a small cycles and these cycles a cycle every one you can see here then theta i you talks of the time taken for the i-th push pull cycle where each push pull cycle is 1. So, forward displacement in the i-th cycle say, i it is equal to 1 to i is equal to 99, i is equal to 100 or whatever or n.

So, forward direction there is a displacement and the i-th cycle then the backward direction in the, same i-th cycle so, in cycle in this; so, x i f and x i b. So, this x i f, x pi B here; that means, we will know actually what distance I have moved. And during this

period what is the time which has taken during the cycle you can see it say from i-th cycle to as say n cycle if you are talking of there are n such cycles. So, total forward distance T, total time T during a weeding trail is you can say that the total forward displacement S can be given as this, where S is over a period of cycles from 1 to n that is x i f minus x i b and then what is the total time we have to take the cycles times during the period.

So, this time has to be from the time it has pushed and then pulled back. So, one cycle is completed. So, there is no detection here that no deduction here, but it will be the total time theta I which talks off the time taken for the i th push pull cycle. In one case, we are talking of push and then, pull and. So, the difference is the one which is the forward, displacement, but the time here is taken as the full push full cycle time.

So, this is the, distance trouble and this is the time taken over here. So, if we know the total quantity of work done. So, this quantity of work done is in fact, quantity of work done Q 2 is given by W b into S by T. Now, this W b is the, work which has been done earlier and S by T is talking of the time and eta f is the frequency, is the efficiency.

So, this, total area per unit of time what will be the total area per unit of time, which we have done already here. So, you can get this here W band then this is what exactly is shown in this case. So, this is the quantity of work done.

Now, slight mechanics has been, given here to understand because it is a push pull type of operation and not a continuous push type of operation not a continuous pull type operation. And we know that, pulling is better than pushing, but here in this case, we cannot move forward by pulling and that is why we are talking of push pull operation pushing, remember that that mechanic says that, pushing is better than and pulling is better than pushing because in pushing you are in case in depth. So, there this is decreased, but in pulling what we have it helps him taking the, it goes this sin alpha which has gone below is goes up when you are pulling it and that is why it is said that pulling is better than pushing.

But, in this case before waiting we are going forward and this is the best operation this is the best mode of operation and that is why push pull weeder and that is why push pull type of cycles has been created to understand the mechanics of this and. So, we have does we discussed this the width of cut W b talks of the width of the cut W weeding

blade total width of the cut W weeding blade S is the total forward T as I said and field efficiency of the weeder.

So, these are the details of how the mechanics of push pull weeder works. Let us, go forward and have a look at what exactly we are talking and how we are measuring different type of blades performance.

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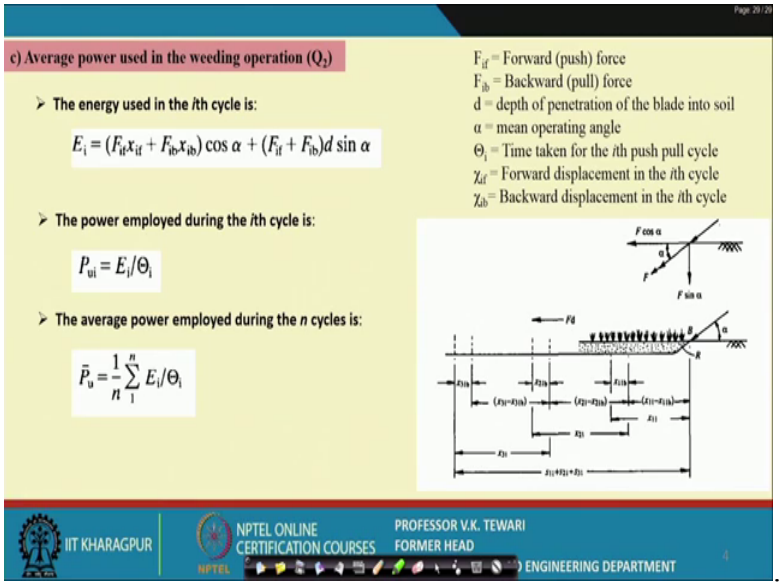

Well, average power used in the weeding operation, what is the average power used well if you talk of the cycles, we have talked of various cycles when we saw in this that various cycles have been used, from cycle i is equal to 1 to i is equal to n. Then average power used in the weeding operation will be then you the average power here will be yeah, this is the X if talks of the forward in the distance displacement and F if we talk of the forward force applied.

So, force into distance is giving you this energy this energy and it is it has to be in the cos alpha direction because it is talking of the, force which we have, applied in that direction. So, this component and then, this now, this although it is d sin alpha we are talking in the other direction, but then we have to take care of this there because we are talking of the total energy because energy it is here, we are not only talking of push and pull. But we are when we are doing this operation we are, utilizing some of the energy for depth also and that is why this d is, kept here and the total energy used in a cycle in the ith cycle say is given by this.

So, over the power we proved for ith cycle is definitely this P ui is given by this where. If, we go back to this here we have talked of the force that we push force F if backward force is this here d is the depth operation a mean angle of operation which we have shown here and also in the previous, diagram I had shown you. Then X ib forward displacement ith cycle and X ib is the, forward at a backward displacement and this cycle.

So, using these we are in a position, to get the average power employed during n cycle. So, if there are n cycles this is the average power here, average power these talks of the average power and these are the, cycles which have been used and you can see that we say so many of these cycles. If you have added distance the these distances are, like this here and then this here, like this how we are adding these small distances and ultimately we are reaching to the total maximum distance that we have covered, and the total area that we have covered. So, this talks of the average power used. So, once we have known these things, we have given the mechanics of push pull weeder.

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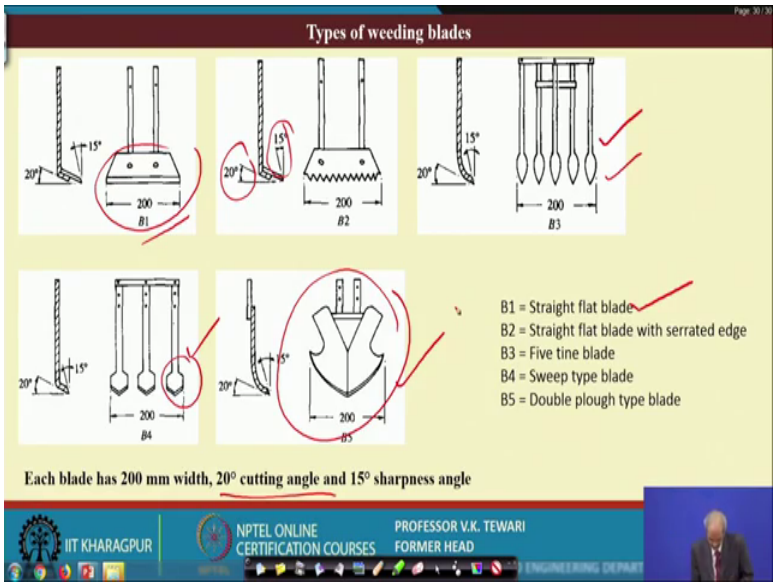

Well, different types of weeding blades using this because we have given what we wanted to do. These are all the, push pull type of weeders which are employed. But, then different designs are used, why? Because the each has, each has it is own, advantage and disadvantage; that is why we have given you these different types and they are named as you can see the straight blade type B1 here the straight blade type which is. in fact, if you

have seen a small weeding device manual this kurpa which was, shown to you, it is just this blade which we which is their similar blade which is taken about 200 mm.

Then, this is a serrated type now this serrated type image helps us in entangled weeds it is, to clear and share of the weeds, it has a given 15 degree, the sharpness angle and 20 degrees the cutting angle. So, each has been maintained by that now, here there are 5 tine blade. There are 5 tines of blades, they gave, some sort of farting operation where you find the divisions not that much, but then you would require to remove the upper crust, so that the aeration takes place the soil will start breathing which is essential for the plants to grow at that moment.

So, there we have found that these ones are, very good the and in fact out of these two this is another, sweep type one where a 200 mm again, but then these are all of the same size, but different, different shapes etcetera depending of where they are used. So, these ones give us, you can say that where, the row to wise spacing is slightly smaller and there you want to go in between and cut.

Now, this is the one which has something, in similarity to this, but then it also, puts the soil on to the, plant which when it is operating between the row crops what will it do it will put the soils on this side on the beneath, plants and that is why, this is advantage over there.

So, it all these 5 types of tines have been used. They have the same width they have same, cutting angle and same the sharpness angle. Now, but they are various, ways now, out of these we would like to find out which one is best for our operation this is what is the, job for this particular lecture that I want to explain to you.

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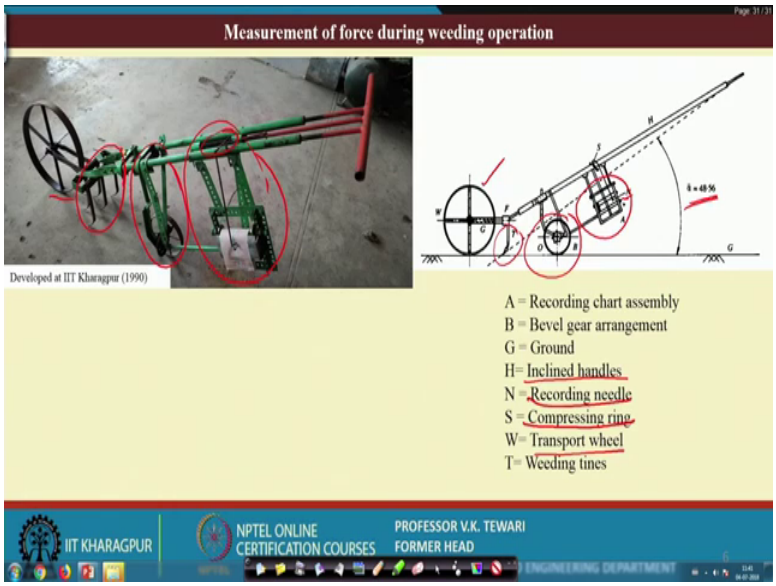

Now, how do we do this, how do we measure these forces etcetera which I talked off, but how do you measure the force. So, we developed this is a one which we have been developed at IIT, Kharagpur. See in fact, then the here you can see here that this, there is a device here there is a bevel gear arrangement in this a small field then, this is the front wheel of the weeder this is the tine which has been kept here and this is a graph and some arrangement has been made that the moment, there is a, pushing of this the, the graph will move on to this a we are maintaining an angle of 48.56 degree.

If the edge, is the inclined handles in total length here, then the recording needle, N is the recording needle over here, this is the recording needle which works in this case. Then compression ring is spring, there is a compression spring which is, here now in this is this is location where the compression ring is, the compression spring is kept. Then, transport wheel of course, W is the transport wheel.

Well, while we say that this transport wheel, but then remember what we have done. In fact, this has been modified the weeder the push pull weeder has been modified into a measuring device force metering device. So, you can see here that, everything else is there what we have done we have used this portion and we have used this portion by which we are in a position to measure what is the force required for operation of this particular one.

So, this is a device also developed at our place and in fact, you will find, my paper, published long back and you will find the details of this unit which has been used since then. It is not available, but we have made it long back and then published and it is being used you can see more details of this unit. So, this is the way we are in a position to get the force. How it comes like that, what is the way by which we see that this force has is available and we are in a position to use this we will see in next slide.

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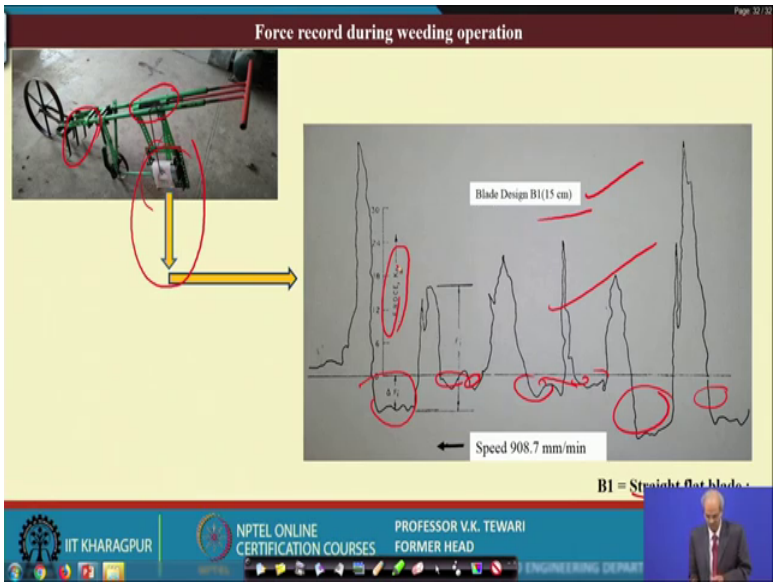

Well, this is how it looks, you can see that this record which we have got this is the record which we have got here this record, looks like, this looks like this you can say any blade B1 blade. Now, this blade now is there and you can see here these are talking of how forward and backward movement you can see forward and backward moment straight one of the blades you know just in order to show you that in one of the blades what were the, particular graph that we got we have shown, you here you can see that, the forward looking force is higher than, it is pulling it.

So, while pulling you are not, exerting any floors except that the you are pulling the whole thing back and since the wheel is there it is easier. So, that is why you will find than each case you can find that these are the small, portions where you are applying the, virtually the force for pulling back and these are the front ones. So, you can for a particular blade. So, this is, the inside on this particular graph, we are getting something like this with a particular type of blade.

Now, so if we change this blade we can find out the this particular graph and hence the force. What we wanted there is the power requirement. So, in order to get the power requirement we wanted to get the force as I have discussed earlier. So, where to measure the force so, we have had this device developed and then we have measured. It looks like this on the graph and from this graph we are in a position as you can see here we are in position to measure what is the force because we know the spring constant of this particular spring. So, we are in a position to find out how much is the deflection accordingly of this and then we can say how much is the force over here.

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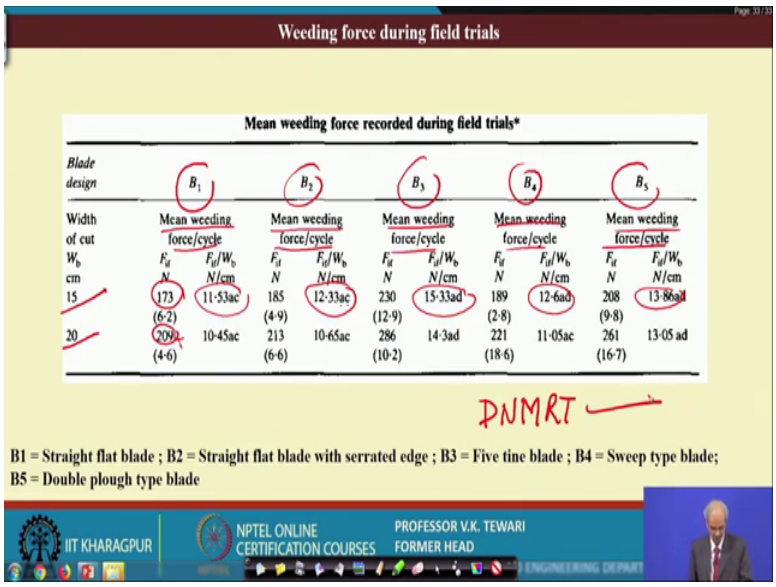

Well, weeding force, during field trials. So, different field trials were done for with these, devices in the actual field conditions these are done under actual field conditions I can tell you. And we have here the different blades the different blade, different blades were here B 1, B 2, B 3, B 4 and B 5 different blades are available with us and in these blades then, I have already shown you what are the types and where they are used and what are the different, features of those blades how they are, beneficial in your condition, so on and so forth.

And, we have talked of the device we I we showed you that only 200 millimeter is the width of cut off each one of them. Now, in this we have employed 2 types of these with 2 weeds one is 15 centimeter that is 150 mm, the other is 200 mm or 20 centimeter. So, with this we have measured all the details. You can have a look at this, what we have

measured. The mean weeding force per cycle, mean weeding force per cycle, mean weeding force per cycle, mean weeding force per cycle, mean weeding force per cycle for each of these B 1, B 2, B 3, B 4, B 5. This is what we have measured.

What we got here? We got these values you can see here. Now, you can see this varies this, the ones which are given these are, the possibly the variations, standard deviations standard deviations here which are given from there because we are talking of the mean weeding force. So, from the mean these are in the brackets we have given the standard deviations. So, mean plus standard deviations in the brackets given here. So, we can see that, B 1, B 2, B 3, B 4, B 5 and if you see the, N by a centimeters that is this force we can see here this, then this here; then this here; then this here and this.

In fact, these a small a, cc etcetera because we had used here, Duncan's, new multiple range, technique DNMRT which was used here, technique DNMRT Duncan's new multiple range technique was used for comparing the means this techniques which is, available. And, that technique I had used that time to compare these mean values of B 1, B 2, B 3 and B 4. So, the ones which are closer; that means, they are very close to this ones are varying that means, they are markley different from those values there is a difference between this.

So, statistically we also found out whether the values which have we have got for B1, B2, B3, B4 and the values which we are comparing they are, how close, statistically and that is why, we use this statical test to find out these details for the two types of the, weeding you can say width of cut of these blades.

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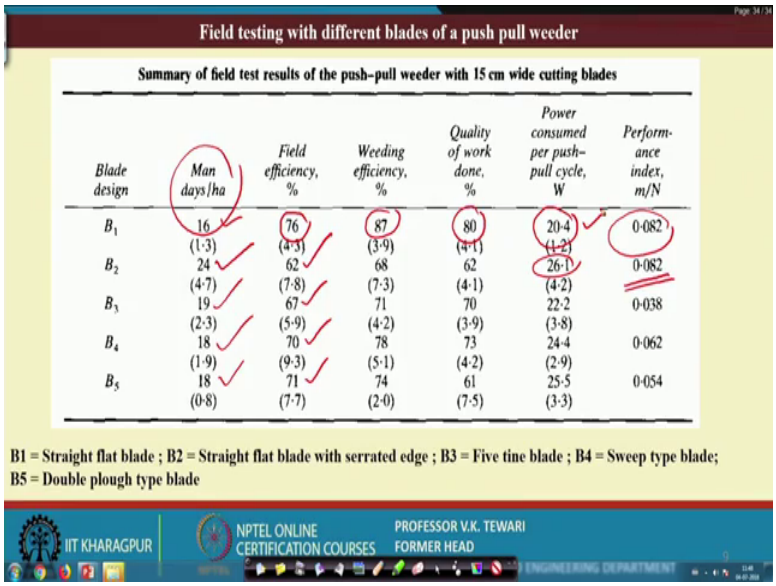

Field testing with different blades of a push pull type weeder now, we have used this, weeder 15 centimeter wide, as I told that we have used for 15 centimeter and then we are talking of 1 for 20 centimeter.

So, we have used all the details. What are those details you, if you see we had talked of the performance when we are talking of the performance of this, in this in fact, we are talking of see man days per hectare is one consideration just to have it and look at it. You see that, man days per is for B 2 we require 24 mandates per hectare. Then B 3 we require 19 and B 4 18, B 5 18 and B 1 we require only 16, man days per hectare.

Field efficiency, we can see that field efficiency is also higher in this case, as compared to, the other, blades 62 here 67, 70 and 71. So, the field efficiency is also here, higher in case of B1. We then weeding efficiency see we very high level of weeding efficiency which we got in this case. There is also very high. Quality of work done, is a good quality of work done using the same, formula which I had given earlier we are in a position to do this. Power consumed, well this is the power consumed here and performance index see you this is the one 0.082.

Although for B2 also we got 0.082, but then you can see these, here, the power consumed is higher as compared to this and therefore, we can say that at 15 centimeter wide row here the B 1 blade is giving better performance. Now, it depends on when you are thinking of different types of situations and conditions in which those blades because

I have described why you why a 5 tine blade or 3 tines sweep or this or a with or a particular type is used.

They have their requirements in different conditions. We have compared here for one condition and their B 1 is found to be the best, but then all these need to be operated under varying conditions. So, you can see that the performance of all these are here as compared to B 1 in a condition they are they are disadvantages, but otherwise they need to be operated.

So, at 15 centimeter weed this is the operation over here for both, for all of them this is B1 is a straight flat blade type which I have shown you, B 2 is straight flat blade type with serrated edges, this then B 3 is, 5 tine blade, B 4 sweep type of blade and 5 to double plough type of blade I very easy and very nice. Sometimes, as I told earlier that, this helps in putting up a little bit of earth on to the, roots of this, particular plants which is helpful particular and say orchard crops or in vegetable crops like potato and all that you would like to put some sort of. So, there this will be very, beneficial.

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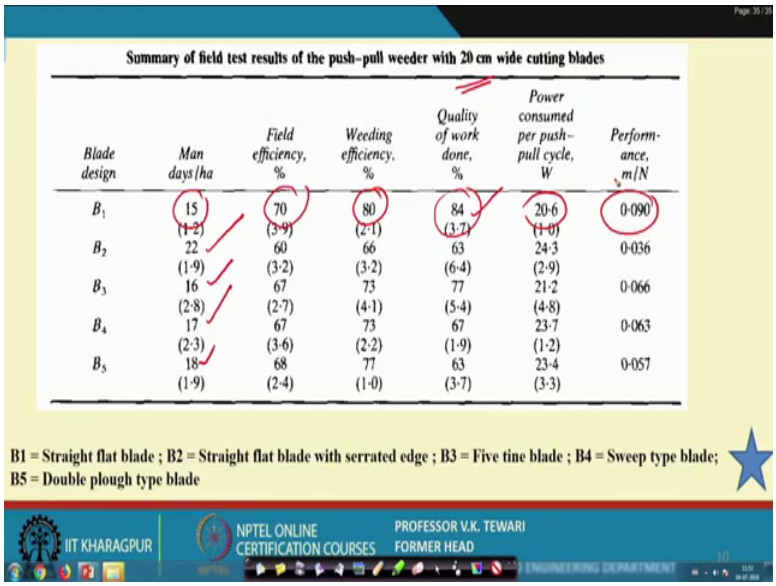

Now, you can see, at the 20 centimeter wide, a similar situation we see here if you compare, the 15 centimeters of, width and 20 centimeter width in the same condition we find that B1 is advantageous, well one may think that I am biased towards, B 1, not so, but in the condition in which, B 3, B 4, B 5 all were used. Now, if they are used in, say

condition which is suitable for B 5. Then you will find that B5 giving is giving better performance as compared to B 1, B 2, B 3.

So, although in a given condition we find that B1 is better see for all these parameters, man days per hectare 15 here, he 22 here, 16, 17, 18 here then field efficiency is higher here and all less are lesser than these. The weeding efficiency is also very high the quality of work done is also very high here.

This is one curve, this has straight blades. The selected ones, in sometimes they leave the, blades and not particular sharpening is taking place that is why, you find, but the quality of work done, quality of work done for B1 is very high the power consumed is less also you can see here, in this case with 20 centimeter wide we do not find the difference which we were seeing earlier that, the performance was better performance index.

So, performance index is 0.09 here or you can say that, maybe, 9, out of 100. We can give here, possibly we are talking with respect to the performance mostly with respect to how much of the quality of work done good quality of work done we got per unit of power that we have utilized. This is what is the one, which we were more interested.

So, as such now in this particular lecture what I wanted to show you is, that a push pull weeder when I did with different cutting elements the cutting elements are those blades which have been used of the same size but of different, configurations. And, of course, each one has it is own applications and suitability in, different conditions of the crop or whether it is a, orchard crop or a cereal crop depending upon what it is, you will find that each has its advantage and that is why all these were tried and we have found out the performance of them. We have found out a mechanics of cutting of push pull type Weeder, which can be utilized anywhere, it is also published as I said and I think we have in a position to give you, the mechanical weeding as such and we have talked of.

Now, we will talk of, the advanced level of, mechanization particularly for these operations in our next lecture where, the idea is to use advanced technology for minimizing, the inputs and maximizing the outputs because we are not getting, labor etcetera. And that is why, up to this we have considered the mechanical, biological system and flame weeding etcetera and now we will talk of the advanced level where sensors electronics and mechatronics things could be used in that will be taken in my

next lecture. And if you have any questions etcetera we are very open, you can send us details to us and we will in position to answer to you and I will thank you for this particular.

Thank you.