Course Name: Basics of Crop Breeding and Plant Biotechnology

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Lecture-09: Backcross Method (Recessive Gene Transfer)

Welcome back. So, we will continue again the backcross breeding method for recessive gene transfer. If our desirable trait is controlled by the recessive homozygous genotype, then how we should conduct the backcross breeding method ok. Suppose we have a particular Lathyrus variety V1 and another variety V2. V1 is having capital P capital P genotype and V2 is having small p small p genotype ok! This variety V2 is showing white flower and we are assuming that this white flower is somehow associated with low ODAP content.

So, it is our target. We need to get this low ODAP content Lathyrus seed, but this variety it is a well accepted variety by the farmers, its yield is high, but it has the toxic compound, its flower colour is purple ok! So, now we are attempting the cross we will get F_1 individuals and F_1 plants will be close to capital P small p. So, here also we do not have to do any selection in F_1 generation ok!

All the F_1 plants will be crossed with the recurrent parent. So, which parent will be recurrent parent over here? Our desirable parent this is our desirable parent ok. Just we need to get the small p allele from the donor parent ok. So, all the F_1 plants will be crossed with capital P capital P individuals that is the recurrent parent. So, if in F_1 generation we cross all the plants with recurrent parent we will get BC_1 generation first backcross generation.

In backcross generation upon crossing between these 2 genotypes we will be getting capital P small p and capital P capital P because here from only 1 types of gametes will be produced and here from 2 gametes will be produced capital P and small p, upon fusion we will get this 2 type of individuals. So, here also we do not have to do any selection ok. So, selection will be of no use over here. If you just recall the dominant gene transfer here from we started selection, but in case of recessive gene transfer here selection will not be effective because our trait… i.e. our targeted trait is controlled by the recessive allele ok. So, here no selection will be done, all the plants will be selfed all the plants will be selfed, means selfing will be done.

If you do selfing then ultimately, we will get BC_1 F_2 generation ok. If selfing is done here from we will get only capital P capital P; while from here we will get capital P capital P, we will get capital P small p, as well as small p small p. 3 types of individuals will be produced from selfing of all these BC_1 generation plants ok! In this generation we can do selection in this generation we can do selection. We are selecting for the flower colour. So, this one will be purple this one will be purple will not collect it only the white flower colour will be chosen and all these plants will be crossed with our recurrent parent.

So, this is our recurrent parent. It will be crossed with capital P capital P. So, then we will get capital P small p individuals again here from this gamete will come here from this gamete will come and this generation is known as BC_2 generation because we are crossing it with the recurrent parent in the previous generation right. So, the BC_2 plants selection is not necessary over here because capital P is supposed to be there all the plants will be crossed again with the recurrent parent all the plants will be crossed again with the recurrent parent upon crossing, we will get BC_3 generation. In BC_3 generation we will be having capital P small p and capital P capital P. This will be our genetic constitution in BC_3 here also selection will not be effective, but we have to do selfing of all the plants we have to do selfing of all the plants in BC_3 generation as capital P allele is there in both types of genotype. So, selection will not be effective, all the flower will be purple in nature.

So, upon selfing we will get BC_3F_2 generation, over there we will get small p small p, capital P small p and capital P capital P right? In this generation we have to do selection we have to do selection will not choose those plants which are showing purple color, will choose those plants which is showing white flower ok! Then again, we have to cross all the white flower plants with the recurrent parent and we will get BC_4 generation. In BC_4 generation our genetic constitution will be capital P small p, all the plants will be crossed with capital P capital P that is our recurrent parent. Once again, we will go to BC_5 generation its genotype will be capital P small p and capital P capital P here we have to do selfing once again.

Next we will go to BC_5F_2 generation. In BC_5F_2 generation genetic constitution will be small p small p, capital P small p and capital P capital P right? We are doing selfing of all these plants. So, over here again we have to do selection process and through selection we can choose these individuals which is showing white color. In next generation we do not have to do any more backcross from BC_5F_2 generation directly we can go to BC_5F_3 generation means all these plants which are showing white color, means which is showing our targeted trait will self all those plants and will collect the seeds of those plants only which is showing rest of the phenotype similar to our recurrent parent. Means selection for flower color and we need to do selection for plant type like our recurrent parent ok! In this way we have to identify those plants and it will be selfed after selfing we have to grow plant to progeny row in next generation that is BC_5F_3 generation.

Now if you carefully see over here only the homozygous recessive individuals for this particular trait is our major concern right. So, it is not supposed to be segregated in this generation. So, here from again we have to do selection some plants are selected and directly we can go to the replicated yield trial directly we can go to replicated yield trial in next generation that generation will be BC_5F_4. There our lines will be grown in different replications along with the standard check variety for yield, for low ODAP content. Those things and thereafter we can move to the seed multiplication. So, basically in this way we can do the backcross breeding for recessive gene transfer.

Now let us discuss about some applications of backcross breeding. First of all, backcross breeding could be conducted for inter varietal transfer of simply heritable characteristics like disease resistance. We have discussed about the crossing of 'Swarna' and 'Tetap' right? 'Swarna' is a rice variety while 'Tetap' is another rice variety. Those are different rice varieties means inter varietal, between 2 different varieties. We can transfer the simply heritable traits. There we are transferring the sheath blight of rice resistant trait ok!

The things could be done through backcross breeding. Next one, inter-varietal transfer of quantitative characters ok! You know some characters are qualitative in nature means those are controlled by 1 or 2 genes; easily we can identify those characters. While some characters are quantitative in nature, means a large number of genes control those traits like the plant height ok! Several genes might be controlling the plant height; the genes responsible for auxin production, cytokinin production they will modulate the length of the cell and those things in this way, the plant height could be controlled by different hormonal genes, different other regulatory genes etc.

So, some quantitative traits could be also transferred through backcross breeding in between one variety to another variety. We can transfer this trait from one variety to another variety. Earliness is another example sorry. Next one is inter specific transfer of simply inherited characters, inter specific transfer. We know that most of the wild germplasm are the resources of many resistant traits.

Like suppose we have *Oryza sativa*, 'Swarna' variety is there that is our desirable type. While 'Swarna' is sensitive to salt stress, but if we consider another wild rice that is *Oryza nivara* that is resistant to salt stress. So, we can transfer the resistance resistant character from this *Oryza nivara* into *Oryza sativa*. Here the genus is same both are *Oryza*, but species is different. So, this inter specific gene transfer of simply inherited traits if it is controlled by one or two genes, if it is controlled by mostly by the genetic factors then we can do it through backcross breeding ok.

Next one the transfer of cytoplasm. In next class we will discuss how through backcross breeding we can transfer cytoplasm. So, the transfer of cytoplasm could also be done through the backcross breeding. Next one is transgressive segregation. During the discussion of pedigree method, we have told that in F_2 onwards in the segregating population if we get some individual that can outperform both the parents those are known as transgressive segregants.

In backcross also if you just recall the couple of previous slides, the F_1 is repeatedly crossed with the recurrent parent ok! In BC_1 whatever we are getting we can cross it with the recurrent parent. So, in these cases the segregation is taken place, different genetic constitution is changed. So, some transgressive segregants could be observed through backcross breeding also. Next one is isogenic line development ok!

We have discussed about 'Swarna' and 'Tetap' variety. Let us assume this one was 'Swarna'. 4 good genes were there and 1 bad gene was there. In case of 'Tetap', 4 bad genes were there, 1 good gene was there ok! We try to transfer this particular trait in 'Swarna'. Upon backcrossing for several generation finally, we can get a 'Swarna' like genotype which will be like this where all the suitable genes will be available, means if you just think about this particular part.

The new variety developed through backcross is almost similar to 'Swarna' except this particular trait isn't it? that is known as the isogenic line. All the genes are same except this particular gene or except a couple of gene. So, these are the different applications of backcross breeding. Thank you.