SIMPLE SELECTION METHODS FOR ANIMAL IMPROVEMENT IN CHINA

I,Selection for One Trait—— Multiple Breeding Value

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Usually there are four sources of records in a breeding farm. They are the record from animals themselves, from their parents, from their sibs and from their offspring. We can combine all the records into a multiple breeding value by a matrix in which the theoretical correlation coefficients between records of different relatives are presented.(S.S.Y.Young,1961; J.S.Wu,1977) We pick out the elements that we need from the matrix and solve a normal equation to find out the partial regression coefficients as the weight factor in the formula of multiple breeding value (MBV),that is

$$MBV = b_1(P_1-\bar{P}) + b_2(P_2-\bar{P}) + b_3(P_3-\bar{P}) + b_4(P_4-\bar{P})$$

Where,

b_i is the partial regression coefficient, P_i is the phenotypic value from different records and $\bar{p}$ is the population mean.

But some breeders felt it was too complex to be used in a farm without a computer. So sometimes we use a simplified formula instead. First we work out single breeding values from each source of data and then, we combine those single breeding value into a mutiple one. The basic formula for estimating a single breeding value is

$$A_X = b_{AP}(P-\bar{P}) + \bar{P} \qquad (1)$$

where,

A_X is the single breeding value of individual X, b_{AP} is the regression coefficient of breeding value on phenotypic value which can be calculated by the following formula:

$$b_{AP} = \frac{nrh^2}{1+(n-1)t} \qquad (2)$$

where,n is the number of records, r is the coefficient of genetic relationship between individual and its relatives, h^2 is the heritability and t is the interclass corelation between phenotypic valus.

The formula of a simplified multiple breeding value is

$$A_X = w_1A_1 + w_2A_2 + w_3A_3 + w_4A_4 \qquad (3)$$

where, A_X is the simplified multiple breeding value; A_1, A_2, A_3, and A_4 are single breeding values of A_X calculated from four sources of records by use of formula (1); w_1, w_2, w_3, and w_4 are weight factors of 4 single breeding values respectively.

Now, the problem is how to determine the weight factor for each single breeding value?

Let us consider the following facts:

(1) Among the four sources of records that we mentioned befor, the records from parents are usually less important than the others.

(2) To those characters which have low heritability, selection based on the records from reasonable number of full-sibs or half-sibs is more reliable than individual records itself.On the contrary, to those characters which have high heritability individual selection can approach a better effect.

(3) Selection based on the records from individual's progeny is usually the most reliable but it takes long time. To those characters which have very high heritability and can be measured on individual itself, selection based on individual records may be more important than its progeny.

So, the importance of different sources of records can be roughly ranked as follows:

(1) For the traits of low heritability (say, $h^2 < 0.2$) the rank of importance from low to high is parents, individual, sibs and offspring.

(2) For the traits of medium heritability (say, $0.2 < h^2 < 0.6$) the rank of importance is parents, sibs, individual and offspring.

(3) For the traits of high heritability (say, $h^2 > 0.6$) the rank from low to high is parents, sibs, offspring and individual.

We say it is roughly, because it have not been calculated accurately. For instance, if the number of offspring is large enough, the selection efficiency which based on the records of offspring would be higher than the efficiency of individual selection no matter whether the heritability of the trait is high or low.

Now, the weight factors can be given if we assume that
(1) four weight factors are different from each other,
(2) the sum of four weight factors is equal to one, that is $w_1+w_2+w_3+w_4 = 1$, and
(3) for the sake of convenience we only take one decimal place.

To satisfy those coditions, the four weight factors can be 0.1, 0.2, 0.3, and 0.4 only.

We substitute 4 weight factors into formula (3), then we have

$$A_X = 0.1A_1 + 0.2A_2 + 0.3A_3 + 0.4A_4 \qquad (4)$$

The meaning of A_1, A_2, A_3 and A_4 in formula (4) depends on the heritability of each trait. When the trait has a low heritability ($h^2 < 0.2$), A_1, A_2, A_3 and A_4 are single breeding values estimated from the records of parents, individual, sibs and offspring respectively. When the trait has a medium heritability ($0.2 < h^2 < 0.6$), they are the breeding values from the records of parents, sibs, individual and offspring respectively. When the trait has a high heritability ($h^2 > 0.6$), they are breeding values from parents, sibs, offspring and individual itseif respectively.

The efficiency of simplified and unsimplified multiple breeding values has been compared by rank correlation and a highly significant coefficient of rank correlation ($P<0.01$) has been found between the two.

The advantage of using a simplified multiple breeding value not only because it is simple but also it can compare the animals which have different sources of records and need not to change the weight factors even if one or two sources of records do not exist. For instance, if the selection is on bulls in dairy cattle. They have no record on milk yield themselves. In this case, the breeding value of a bull is

$$A_X = 0.1A_1 + 0.2A_2 + 0.4A_4$$

where, A_1 is the breeding value from its mother's records, A_2 is the breeding value from its half-sibs' records and A_4 is the breeding value from its daughters' records. Assuming that the heritability is 0.3.

If it is a young bull which has no records from its daughters' milk yield, then its breeding value of milk yield will be

$$A_X = 0.1A_1 + 0.2A_2$$

SUMMARY

The simplified selection methods that we often use in China are multiple breeding value and selection index. Multiple breeding value only deals with one character in which records from the animal itself and its relatives are combined as one. The advantage of using a simplified multiple breeding value not only because it is simple but also it can compare the animals which have different sorts of records and need not to change the weight factors even if one or two sorts of data are missing. A highly significant correlation has been found between simplified and unsimplified multiple breeding value.

Selection index deals with more than one character. The procedure of calculating an index can be greatly simplified by using the method of diagram Details of making a calculating diagram are presented.

RESUMEN

Los métodos de selección simplificados que usamos con frecuencia en China son: el "valor de cria" multiple y el "índice de selección". El valor de cria multiple solo trata con un caracter en donde la información del mismo animal se combina con la de su familia. La ventaja de utilizar un metodo simplificado para el cálculo de este valor es, además de su simpleza, la posibilidad de comparar los animales que tienen diferentes tipos de registros sin necesidad de cambiar los coeficientes, aun en aquellos casos en que no se tiene alguna de las fuentes de información. Se ha encontrado una correlación altamente significativa entre el valor simplificado y valores obtenidos con metodos mas elaborados.

La teoría de índices de selección trata con la combinación de mas de un caracter. El procedimiento para calcular un índice puede ser simplificado sustancialmente utilizando el método del "diagram". Se describen los detalles de este método para construir un índice.

REFERENCES

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