

REPEATABILITY OF SELECTION RESPONSE IN DIFFERENT MOUSE POPULATIONS

Repetabilidad de la Respuesta de la Selección en Diferentes Poblaciones de Ratones

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Two mouse populations, a cross of four inbred strains (population A) and outbred albino mice (population B) were mass selected in divergent directions for eight weeks body weight and 3 to 5 weeks body weight gain over 12 generations, with two replicates each.

In the basepopulations males and females were allotted randomly to selection lines with one replicate and control lines with two replicates. Thereafter each line was maintained as a closed population and was bred from eight single pair matings in each generation. The litters were standardized in population A to eight and in population B to ten at the day of birth. We weaned the mice 21 days after birth and recorded individual weight to the nearest one tenth of a gram at three, five and eight weeks of age. Heritability estimates for the body weight traits in the unselected basepopulations are given in Table 1.

Table 1: Heritability Estimates - Basepopulations

Analysis	Population A		Population B	
	8 weeks body weight	3 to 5 weeks gain	8 weeks body weight	3 to 5 weeks gain
full-sib	.40 ± .05	.32 ± .05	.56 ± .06	1.00 ± .06
half-sib	.34 ± .12	.08 ± .08	-.36 ± .11	-.24 ± .12
daughter-dam	.29 ± .08	-.07 ± .11	.38 ± .06	.25 ± .10
son-sire	.26 ± .08	.15 ± .09	.34 ± .08	.14 ± .07

Selection Response Up TO Generation 12

In both populations the control lines maintained a steady level with no significant time trend. Therefore the response was taken as deviation of a selected line mean from the mean of all control lines (Table 2).

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Table 2: Selection Response-Regression of Weight Responses On Generation Number (grams per generation)

direction	Population A		Population B	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
high 8	¹ .82**	¹ .79**	.53**	.72**
low 8	-.31**	-.32**	-.74**	-.84**
high 3 to 5	.26**	.26**	.28**	.42**
low 3 to 5	-.09*	-.10*	-.34**	-.26**

¹ up to generation 8
significantly different from zero *P < 0.05; **P < 0.01

All lines progressed under selection. However in population A responses were asymmetrical with close agreement between the replicates. In this population we observed an immediate asymmetry; downward selection was less efficient. After generation eight the high 8 lines approached a limit, no further progress was made by selection. In population B greater variation between the replicate's responses became evident, which was slightly reduced during the selection.

Realized Genetic Parameters

The realized heritabilities were calculated from the regression of cumulated selection responses on cumulated selection differentials. The variances of the regression coefficients were estimated with the formula given by HILL (Biometrics 28, 767-780, 1972). The selection differentials of the parents were weighted according to the number of offsprings measured (Table 3).

Similar to the selection responses, realized heritabilities are distinctly asymmetrical in the lines derived from the cross of the four inbred strains (population A) whereas in the lines derived from the outbred population (population B) no significant

differences between the two directions exists. In both populations the mean realized heritabilities agree best with the son-sire regression estimates from the basepopulations.

Table 3: Realized Heritabilities

direction	Population A		Population B	
	Replicate 1	Replicate 2	Replicate 1	Replicate 2
high 8	¹ .34 ± .01	¹ .32 ± .01	.21 ± .01	.23 ± .01
low 8	.23 ± .02	.18 ± .01	.23 ± .01	.30 ± .02
divergence	.26 ± .01		.24 ± .01	
high 3 to 5*	.15 ± .01	.14 ± .01	.12 ± .02	.15 ± .01
low 3 to 5	.07 ± .03	.07 ± .03	.11 ± .01	.13 ± .01
divergence	.11 ± .02		.13 ± .01	
¹ up to generation 8				

Realized genetic correlations, calculated from direct and indirect selection response, are given in Table 4; their variances were estimated with the formula given by HILL (Biometrics 27, 293-311, 1971).

Table 4: Realized Genetic Correlations

lines	Population A	Population B
high 8/(3 to 5)	¹ .79 ± .07	.76 ± .09
low 8/(3 to 5)	.47 ± .11	.81 ± .08
divergence	.63 ± .08	.78 ± .09
¹ up to generation 8		

The genetic correlations realized by upward selection in population A and B are $.79 \pm .07$ and $.76 \pm .09$ respectively and agree with genetic correlations between weight traits realized by selection in other mousepopulations (Mc CARTHY & DOOLITTLE, Genet. Res. 29, 133-145, 1977; RUTLEDGE et al. Genetics 75, 709-726, 1973). In the cross strain (population A) asymmetry of the genetic correlation became evident too, the two values being, $.79 \pm .07$ by upward and $.47 \pm .11$ by downward selection respectively.

Further investigations are made for long term effects of selection and its correlated effects on litter size, longevity, physiological and morphological traits. The selection results indicate that repeatability of selection response may vary between populations. The asymmetry of heritabilities realized in the cross strain could be due to genetic asymmetry. In the unselected basepopulation regressions of offspring on parents for the body weights were non-linear too.

Summary

Two mouse populations, outbred albino mice and a cross of four inbred strains were selected divergent in directions for eight weeks body weight (8 w) and 3 to 5 weeks body weight gain (G) over 12 generations, with two replicates each. The cross of the inbred lines showed asymmetry of selection response and realized heritabilities (+8 w .33 ± .02; -8 w .20 ± .02; +G .14 ± .01; -G .07 ± .02) with close agreement between the replicates. In the outbred population greater variation between the replicate's realized heritabilities became evident and no significant asymmetry of selection response could be found (+8 w .25 ± .03; -8 w .22 ± .02; +G .13 ± .02; -G .12 ± .01). In both populations realized heritability estimated from the divergence agreed with the prediction from offspring-father regression in the base populations.

Resumen

Dos poblaciones de ratones, una albina obtenida por exocria, y la otra obtenida por cruzamiento de cuatro líneas endocriadas, fueron sometidas a una selección divergente, durante doce generaciones, con dos repeticiones en cada generación. Se consideraron los siguientes parámetros: peso a las 8 semanas (8 w.), y ganancia de peso entre la tercera y la quinta semana (G). La cruz de las líneas endocriadas muestra una respuesta a la selección asimétrica, y heredabilidades realizadas (+8w.33 ± .02; -8 w.20 ± .02; G .14 ± .01; -G.07 ± .02) que concuerdan estrechamente entre las repeticiones. En la población obtenida por exocrias hace evidente una mejor variación entre las heredabilidades realizadas de las repeticiones, y no se encontró una asimetría significativa en la respuesta de la selección (+8w.25 ± .03; -8 w .22 ± .02; +G .13 ± .02; -G .12 ± .01). En ambas poblaciones, la heredabilidad realizada estimada a partir de la selección divergente concuerda con la estimación a partir de una regresión progenie-progenitor en la población base.