THE EFFECT OF PARENTAL RELATEDNESS ON THE FITNESS IN NEXT GENERATION OF THE GUPPY *Poecilia reticulata*

Muhammad S. ISMAIL[1, 2],

Toyoko NAKAJIMA[1], Masamichi NAKAJIMA[1]

1 : Graduate School of Agricultural Science, Tohoku University, Sendai, Japan

2 : Aquaculture Department, Universiti Putra Malaysia, Selangor 43360, Malaysia

The Prediction of the Effect of Inbreeding and Evasion of Depression

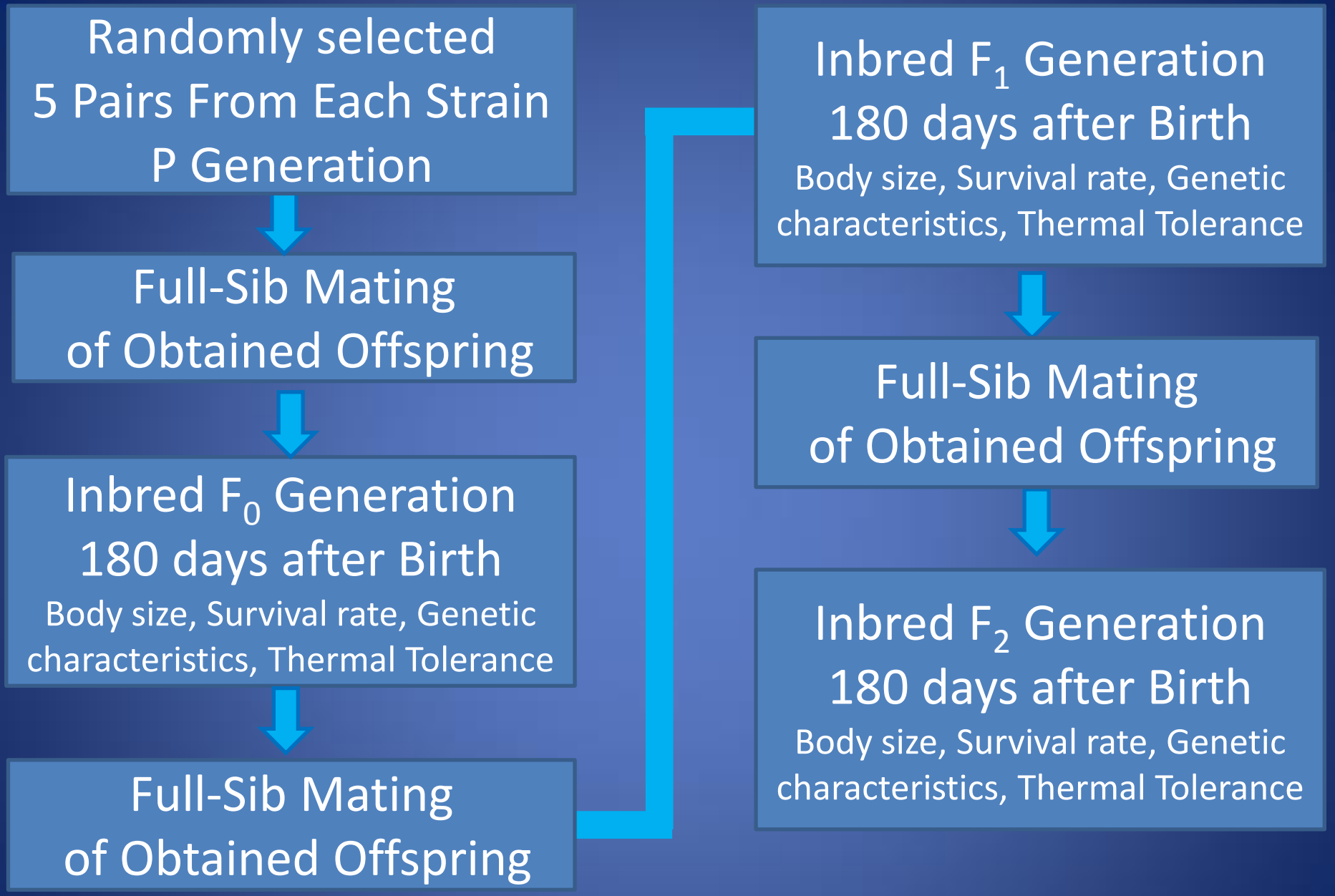
- For the maintenance of genetic variability, large number of parental fish are required
- However, there is an limit of number of individual maintained as parental fish
- If we can predict the effect of inbreeding from heterozygosity and/or relatedness in the parental generation, the inbreeding depression on the next generation could be evaded
- Can inbreeding depression predict from parental heterozygosity?
- Can inbreeding depression predict from parental relatedness?

Maintained Condition
Water Temperature : 23±2℃
Light-Dark condition : 14L、10L
Density : 200 ~ 300 individuals in 60L Aquarium
Feeding of Diet : Twice a Day

AY Strain : Collected from the stream from Ayutthaya, Thailand at Dec. 2012

Na-1 Strain : Collected from the stream Okinawa, Japan at Jul. 1999

Strains Used for This Study



Experimental procedure

Genetic Markers

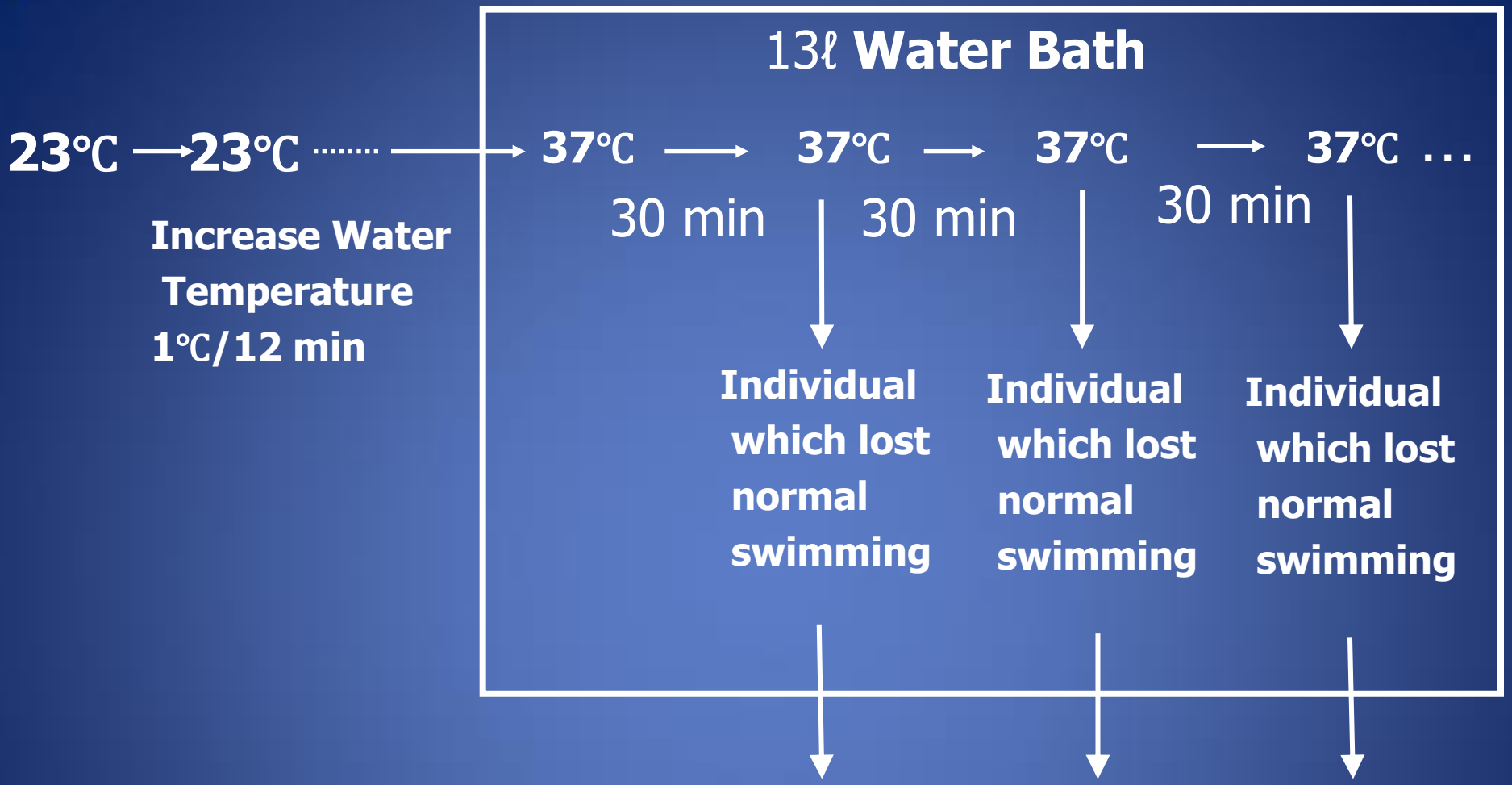
Microsatellite DNA Markers : *ATCC2, AC3, AGAT11, Pret-46, Pret-49, Pret-69, Pret-71, Pret-72、Pret-80*

Evaluation of Genetic Variability :

Individual Heterozygosity,
Standardized Heterozygosity,
Mean Family Internal Relatedness,
Parental Relatedness

Evaluation of Fitness : Thermal Tolerance (TT)

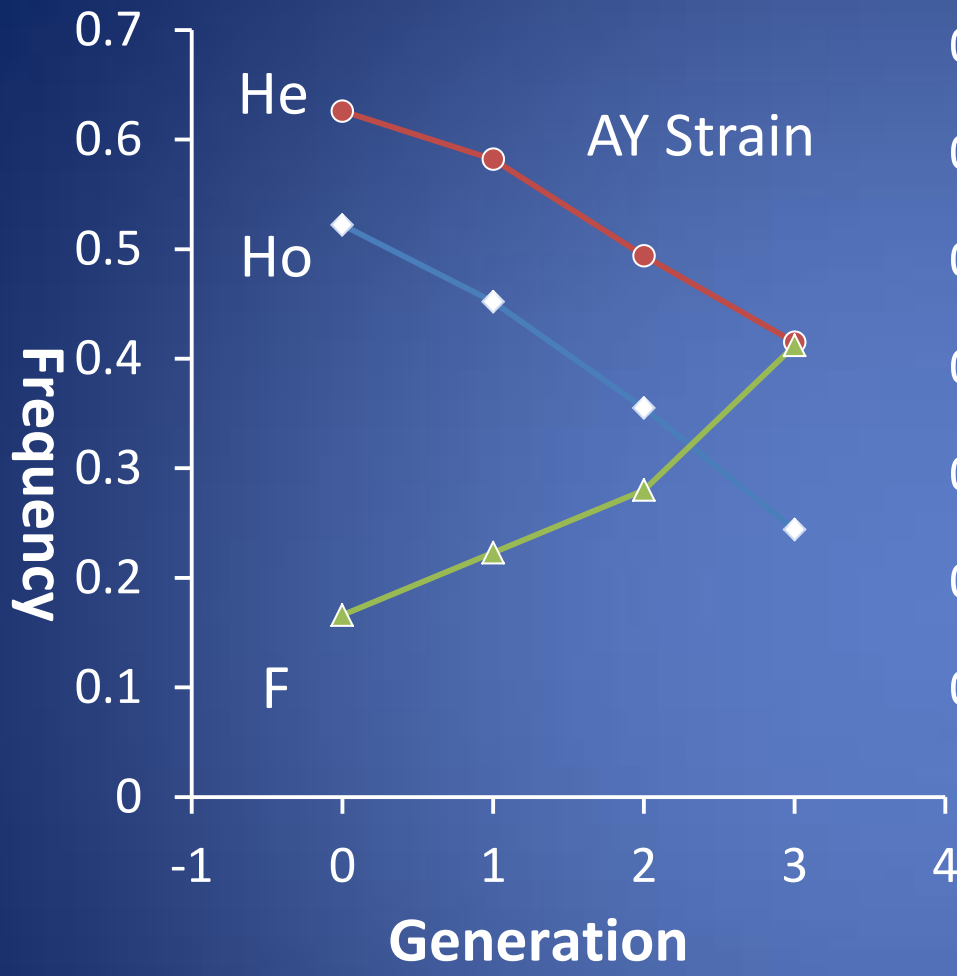
Statistical Analysis : ANOVA, Multiple Regression Analysis

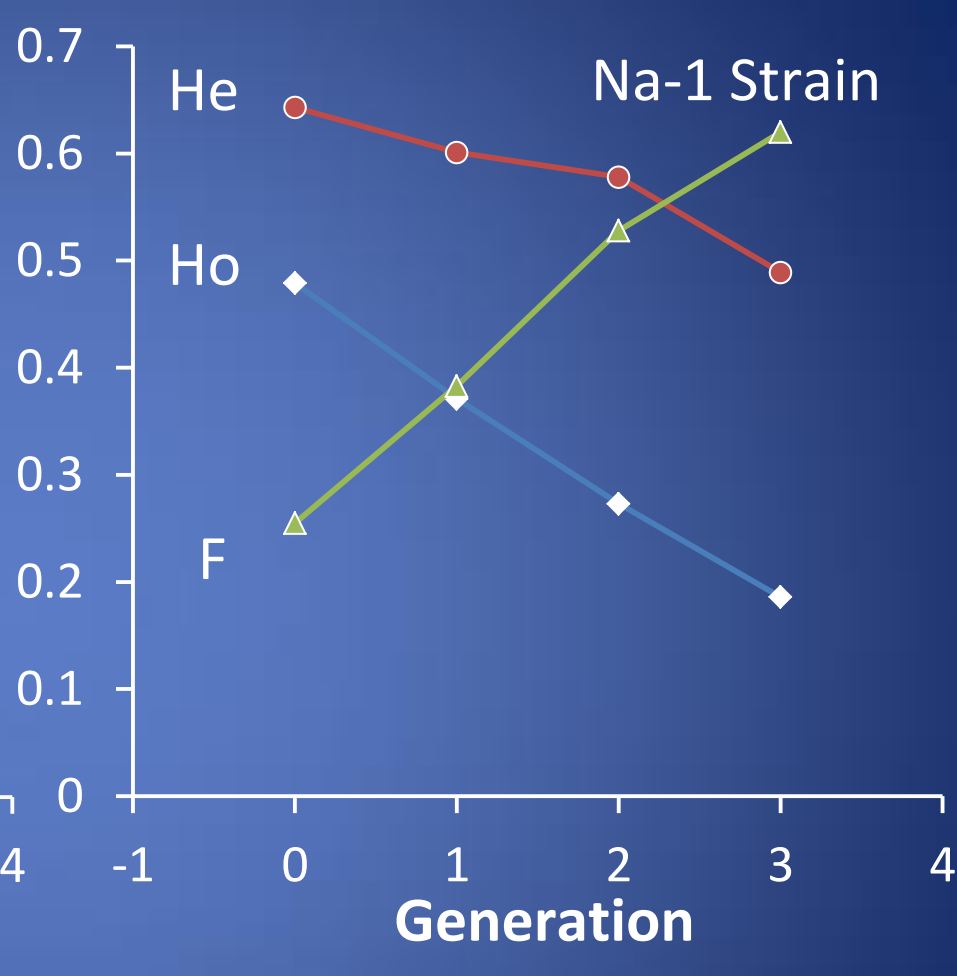


Evaluation of Thermal Tolerance

Survival Rate at 180 Days Old in each Generation

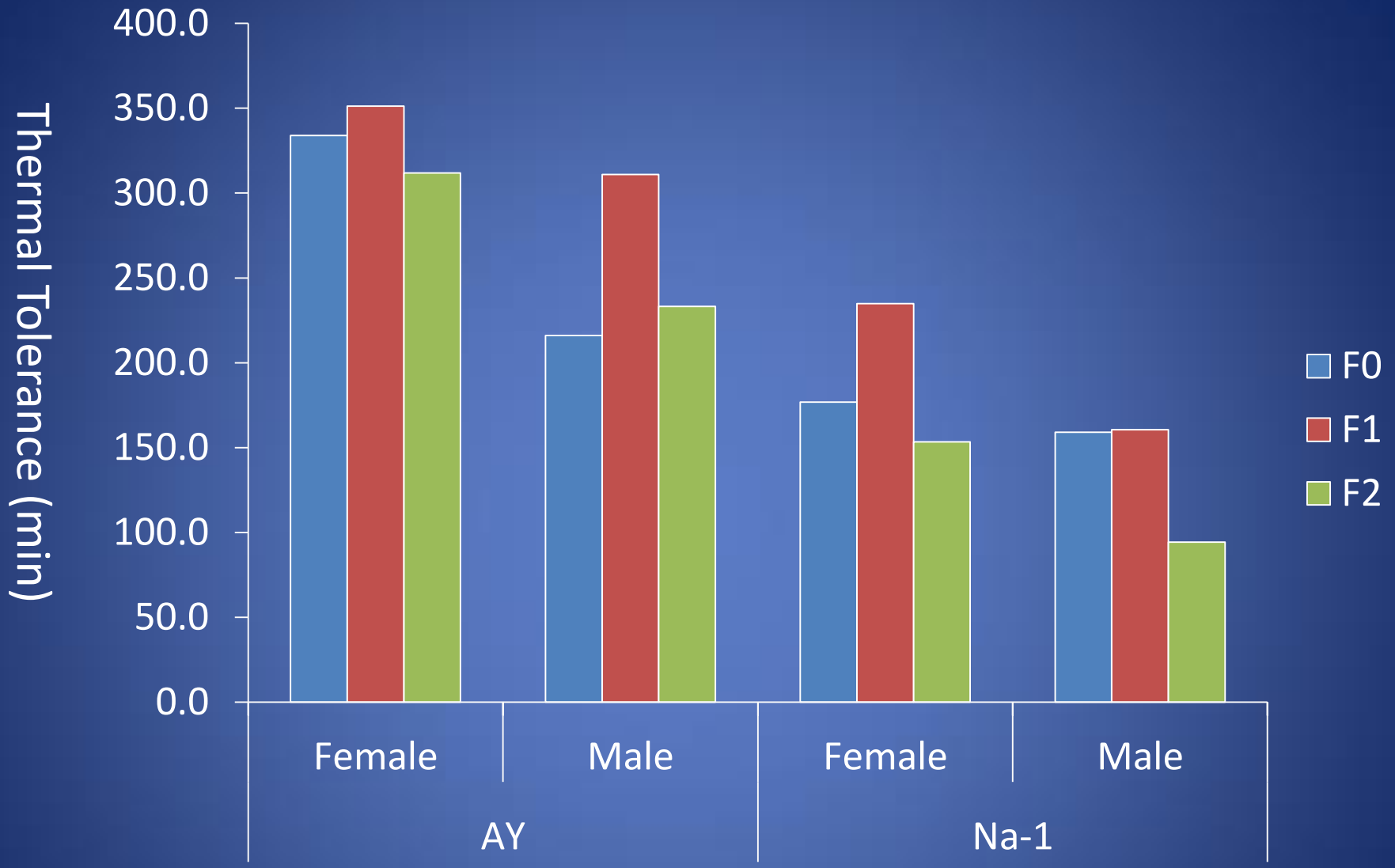
	AY			NA-1		
Generation	No. of Family	No. of Individual	Survival rate±SD	No. of Family	No. of Individual	Survival rate±SD
P	5	10		5	10	
F_0	26	112	0.89 ± 0.23^a	59	238	0.92 ± 0.15^a
F_1	62	245	0.80 ± 0.29^b	56	230	0.79 ± 0.23^b
F_2	29	148	0.80 ± 0.26^b	48	181	0.75 ± 0.22^c
F_3	35	112	0.75 ± 0.30^c	58	243	0.74 ± 0.29^c



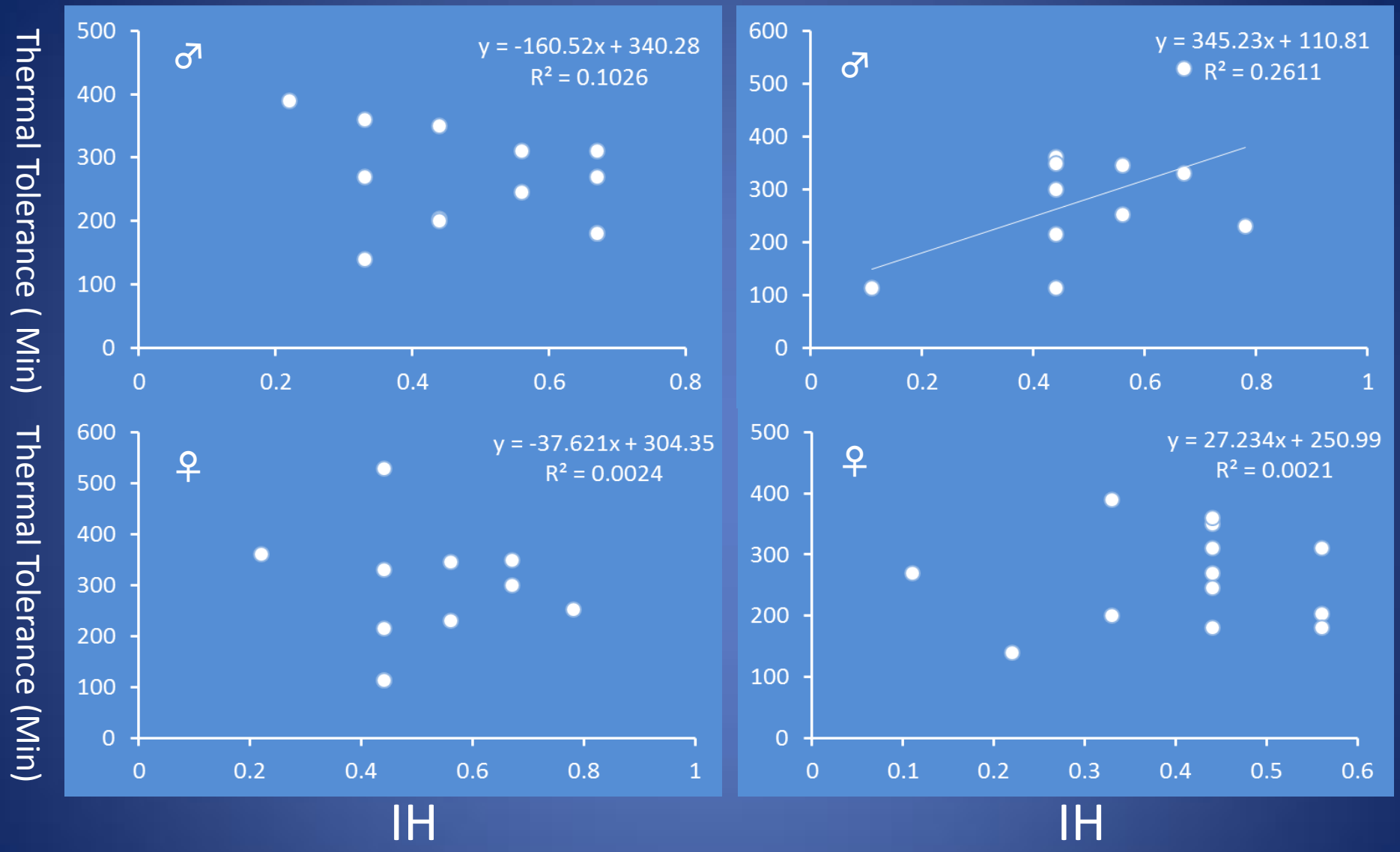


$F = (He - Ho) / He$

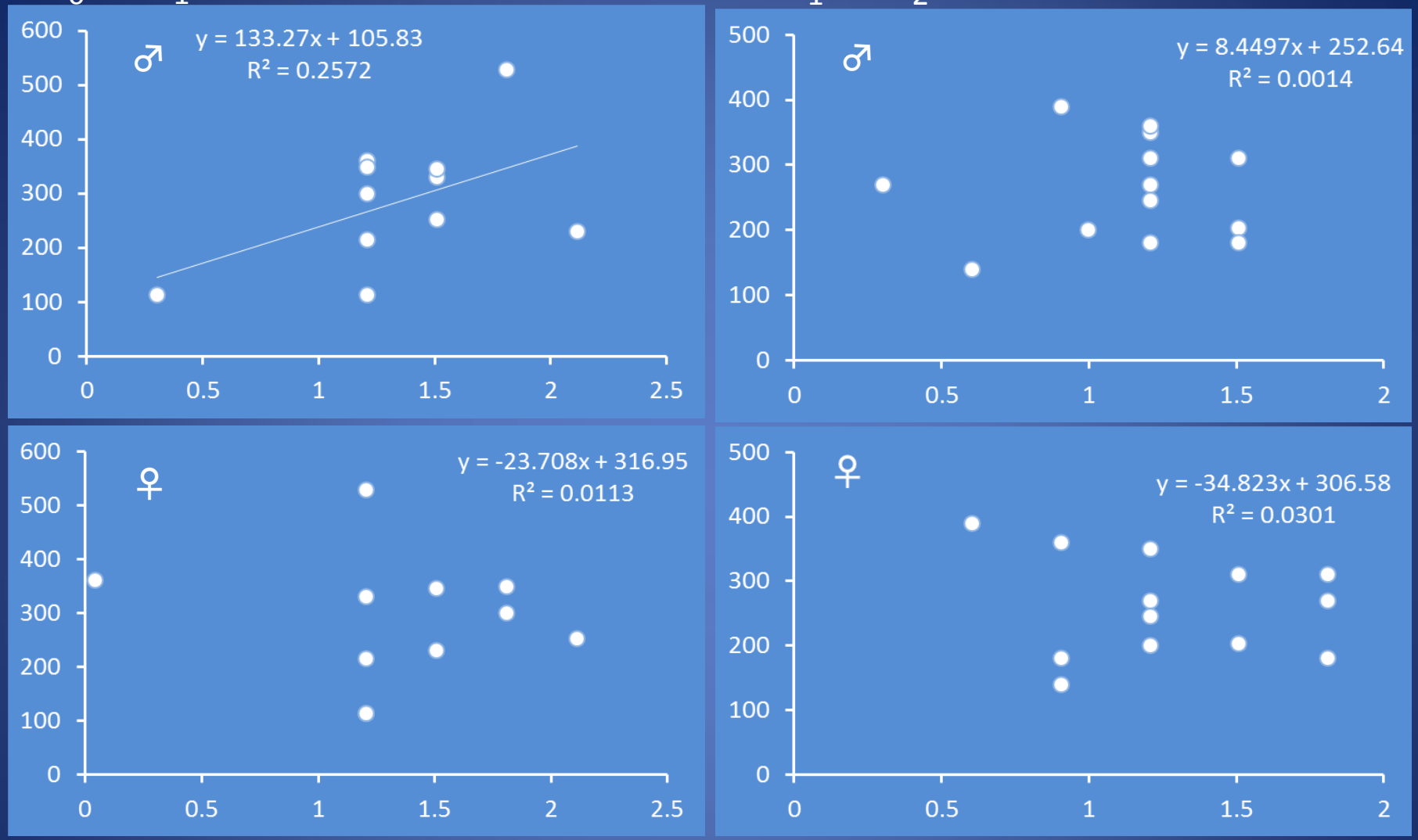
Change of Genetic Characteristics According to Inbreeding Generation



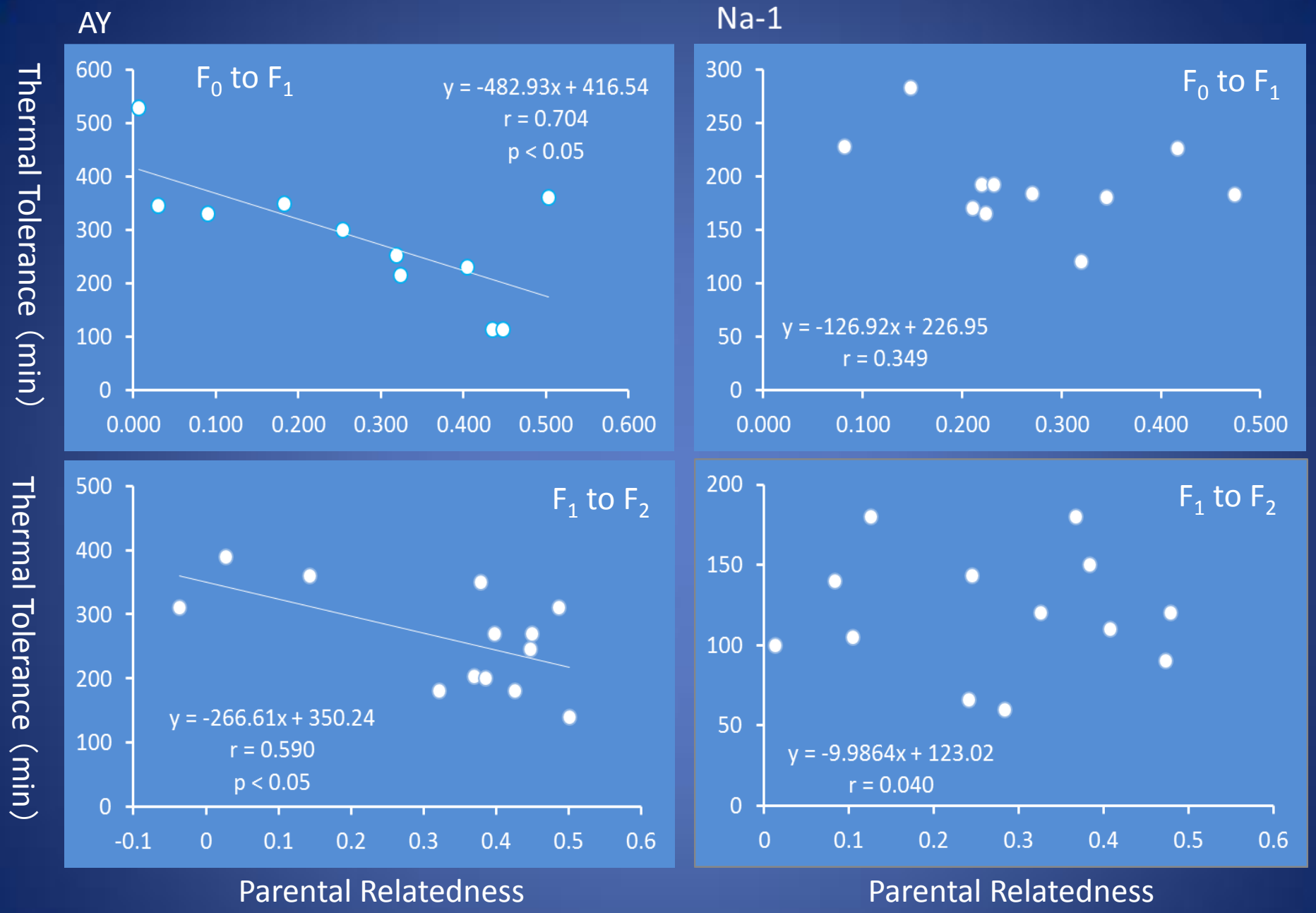
Change of Thermal Tolerance According to the Inbreeding Generation



Correlation Between Parental Individual Heterozygosity and Thermal Tolerance in Their Offspring (AY strain)



Correlation between Parental Standardized Heterozygosity and Their Thermal Tolerance (AY Strain)



Correlation between Parental Relatedness and Thermal Tolerance in Their Offspring

Multiple Regression Analysis

- Response Valuable : Thermal Tolerance

- Explanatory Valuable : Generation, Strain, Sex, Individual Heterozygosity, Standardized Heterozygosity, Parental Relatedness, Mean Family Internal Relatedness, Parental Thermal Tolerance

Results of Multiple Regression Analysis

Valuable	Partial regression coefficient	Standard Error	Standardized Partial Regression Coefficient	P value	
Generation	-52.091	18.438	-0.178	0.0051	**
Strain	127.146	16.375	0.443	0.0000	**
Sex	69.231	13.953	0.240	0.0000	**
IH Male	-261.618	360.662	-0.267	0.4689	
IH Female	-303.891	127.622	-0.407	0.0180	*
SH Male	152.421	134.014	0.407	0.2565	
SH Female	91.055	43.658	0.310	0.0381	*
Parental Relatedness	-227.163	48.301	-0.256	0.0000	**
MF IR	23.943	98.964	0.034	0.8090	
Parent Male TT	-0.144	0.089	-0.095	0.1048	
Parent Female TT	0.080	0.061	0.092	0.1933	
Constant	228.620	93.193		0.0149	*

** : $P < 0.01$ * : $P < 0.05$ $R^2 = 0.438$ $p = 0.000$

Results of Multiple Regression Analysis

Valuable	Partial regression coefficient	Standard Error	Standardized Partial Regression Coefficient	P value	
Generation	-52.091	18.438	-0.178	0.0051	**
Strain	127.146	16.375	0.443	0.0000	**
Sex	69.231	13.953	0.240	0.0000	**
Parental Relatedness	-227.163	48.301	-0.256	0.0000	**

Generation → Decrease of fitness according to generation

Strain → AY is stronger than Na-1

Sex → Female is stronger than male

Parental Relatedness → Parental genetic similarity influence to the fitness of next generation

Conclusion

- Parental relatedness and thermal tolerance in their offspring indicated negative regression.
- Negative regression indicates that the high similarity in parents leads low fitness in next generation.
- It was suggested that the inbreeding depression in the offspring generation could be predicted from the parental relatedness.