GENETIC GAIN IN OPEN NUCLEUS BREEDING SCHEME TO IMPROVE MILK PRODUCTION IN EGYPTIAN BUFFALO

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S.A. Abdel-Salam
Faculty of Agriculture, Cairo University, Egypt

INTRODUCTION

- **FAOSTAT (2009) the Egyptian buffalo contributes about 2.7% and 8.4% to the world buffalo's milk and meat.**
- **The proportion of Egyptian buffaloes to the world buffalo's milk production decreases year after year.**
- **The increase of total milk production of Egyptian buffaloes was due only to increasing buffalo population size.**

INTRODUCTION

- Livestock production in developing regions is generally characterized by small herd-size, uncontrolled mating, and the absence of pedigree and performance recording.
- These characteristics limit the implementation of effective genetic improvement programs.

INTRODUCTION

- To overcome these problems, nucleus breeding schemes have been suggested, in which genetic improvement is centrally organized in a population maintained in research institutes or government farms.
- The open nucleus breeding scheme offers a simpler procedure for producing and disseminating breeding stock of known value.

INTRODUCTION

- **The establishment of two-tier open nucleus breeding system to maximize genetic improvement, reduce inbreeding rate and reduce the total cost of recording in smallholder system.**
- **Several of studies indicated the significance of using open nucleus breeding scheme to improve milk production of buffalo and increase the rate of genetic gain.**

INTRODUCTION

- The purpose of this paper was to use the simulation technique to study the expected genetic gain by changing migration rates and male selection intensity in four generations of applying two-tier open nucleus breeding scheme to improve milk production of Egyptian buffaloes using different nucleus and population sizes.

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MATERIAL AND METHODS

Basic parameters

The estimates used in generating the simulated populations

Parameter	Estimate	Reference
Average total milk yield (TMY)	1884, kg	CISE, 2007
Phenotypic variance for TMY	191845, kg^2	CISE, 2007
Phenotypic standard deviation for TMY	438, kg	CISE, 2007
Average generation interval	5.78, yr	Mourad, 1990
Heritability estimate	0.17	CISE, 2007

CISE: Cattle Information Systems/Egypt

Calculation of the expected genetic gain in milk yield

Input variables for calculating genetic gain

Item Description	Symbol	Value
Heritability estimate	h^2	0.17
Replacement rate	r	0.20
Fraction of total population in nucleus	p	0.05, 0.10
Fraction of nucleus dams born in base	x	0.50
Fraction of base dams born in nucleus	y	0.08, 0.14, 0.17
Fraction of nucleus sires born in base	v	0.00
Fraction of base sires born in nucleus	w	0.10, 0.20, 0.30, 0.60, 1.00
Proportion of all males born used as sires	a	0.05, 0.10, 0.20
Proportion of all females born used as dams	b	0.80
Simulated population size (number of breedable females)	z	10000, 25000, 50000, 100000
Generations	G	1, 2, 3, 4

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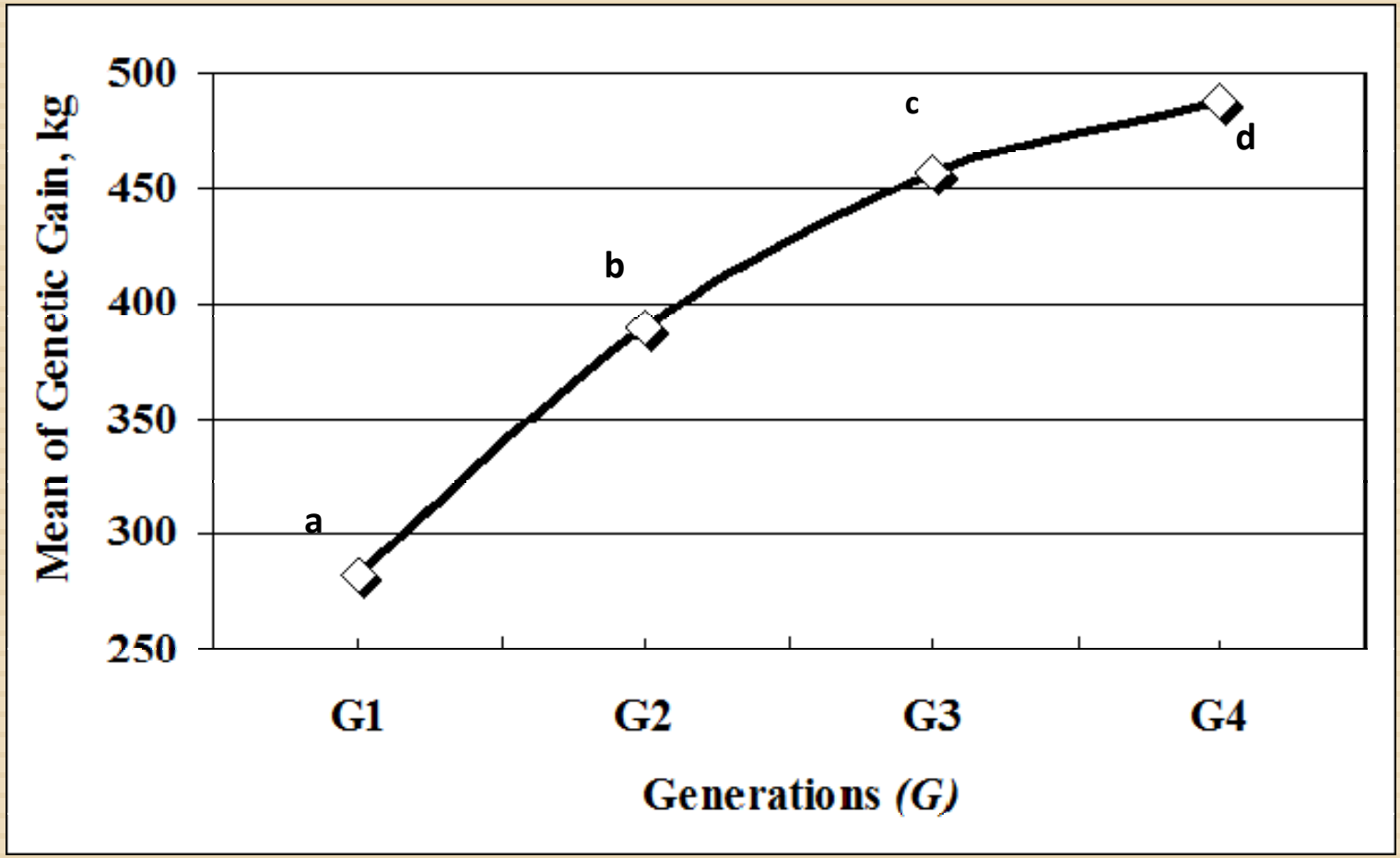
Structure of breeding scheme and gene migration

The effects of the different variables on genetic gain were analyzed according to the following model:

$$GG_{ijklmnop}=\mu+G_i+z_i+p_k+a_l+MR_m+w_n+y_o+e_{ijklmnop}$$

where GG is the genetic gain of milk yield, μ is the average genetic gain of milk yield, G_i is the number of generation (4 level), z_i is the population size (4 level), p_k is the fraction of total population in nucleus (2 levels), a_l is the proportion of all males born used as sires (3 levels), MR_m is the mating ratio (6 levels), w_n is the fraction of base sires born in nucleus (5 levels), y_o is the fraction of base dams born in nucleus (3 levels) and $e_{ijklmnop}$ is the residual term.

RESULTS AND DISCUSSION



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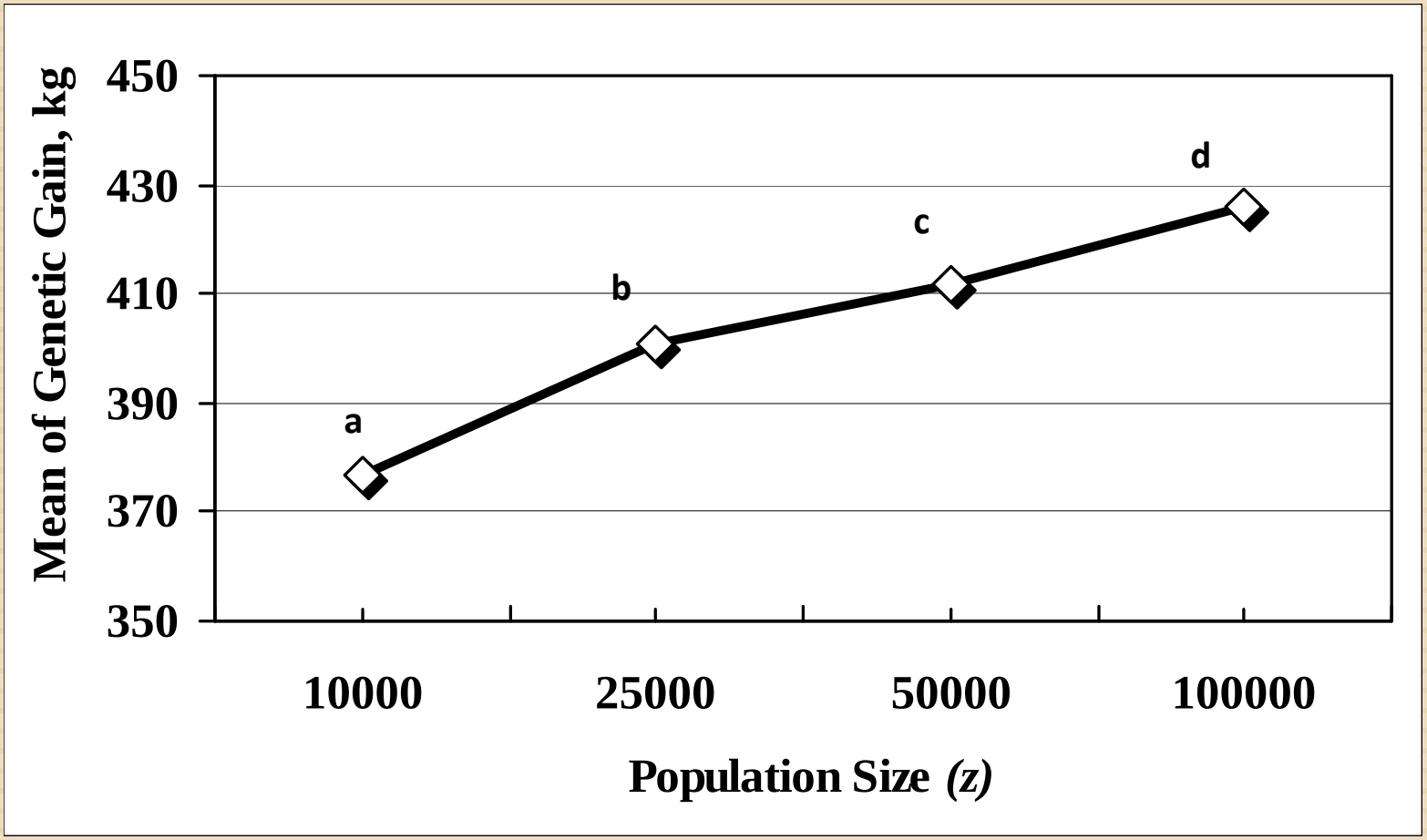
[a,b,c,d]Means with different letters differ significantly ($P<0.05$).

Change of genetic gain means by generation number.



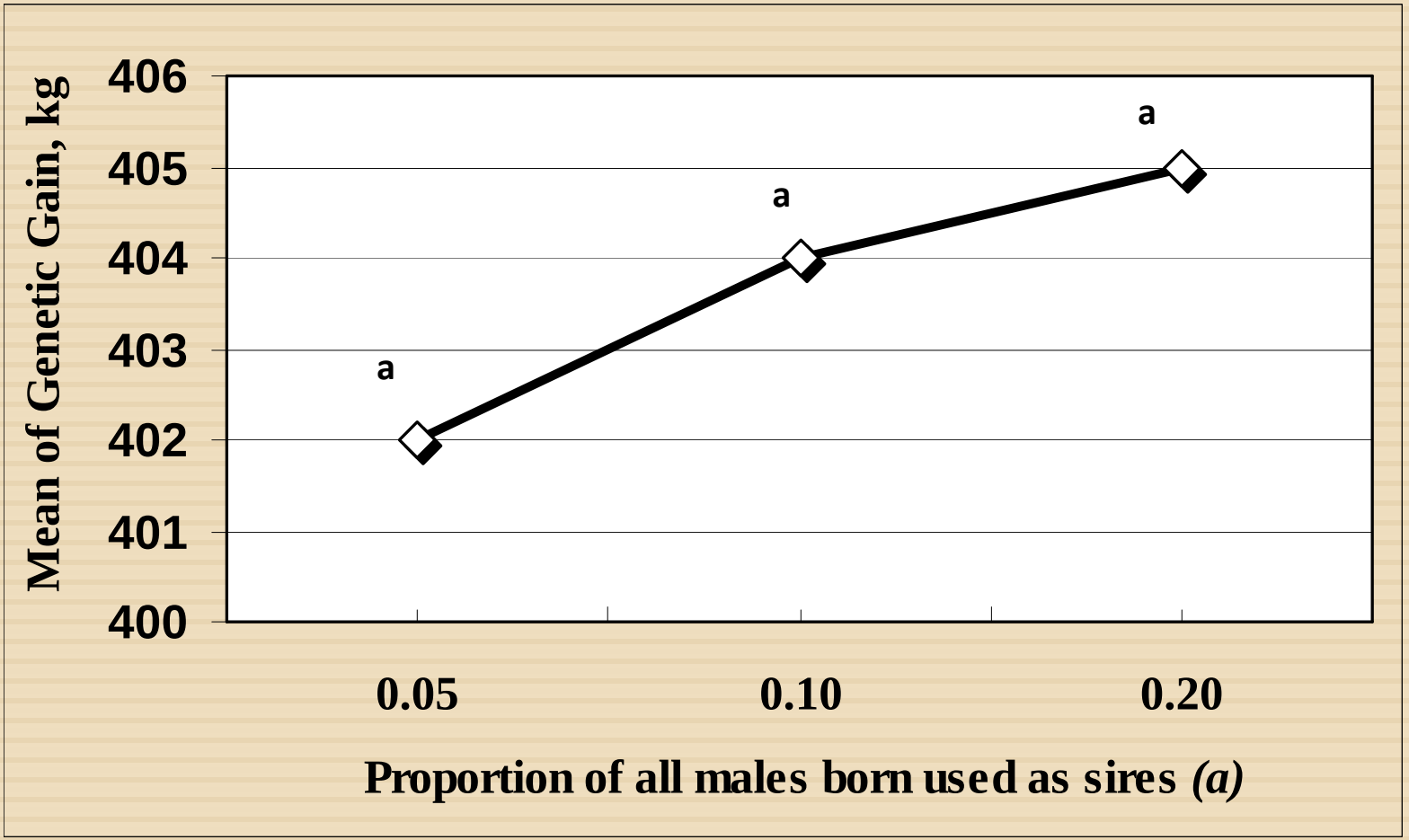
[a,b,c,d]Means with different letters differ significantly ($P<0.05$).

Change of genetic gain means by changing population size (z).

Least squares mean and standard errors (SE) of genetic gain of milk yield (kg) in simulated buffalo populations of different nucleus sizes (*p*)

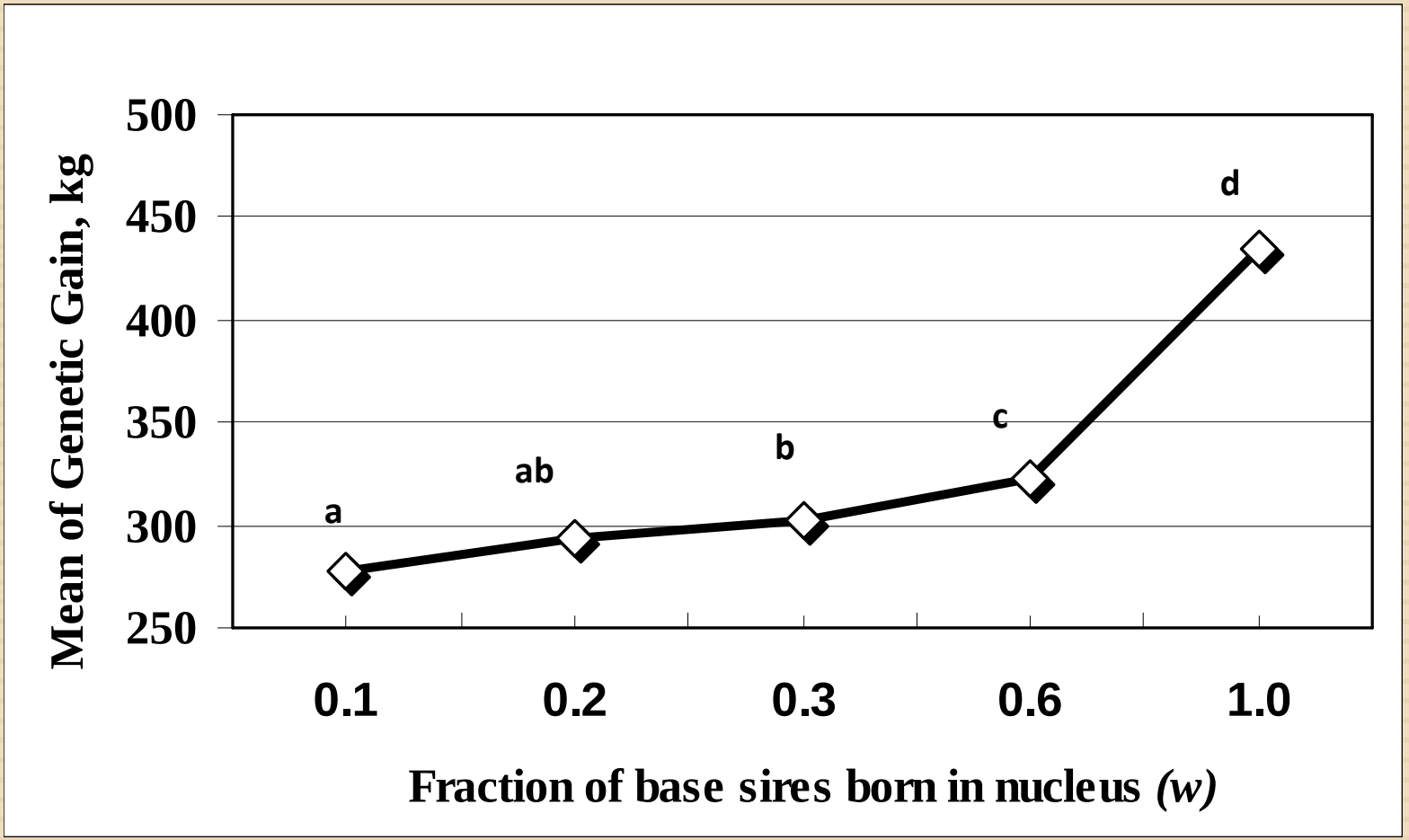
p	Mean	SE
0.05	397[a]	7
0.10	415[b]	6

[a,b]Means with different letters differ significantly (*P*<0.05)



[a]Means with same letters do not differ significantly ($P>0.05$).

Change of genetic gain means by changing proportion of all males born used as sires (*a*).



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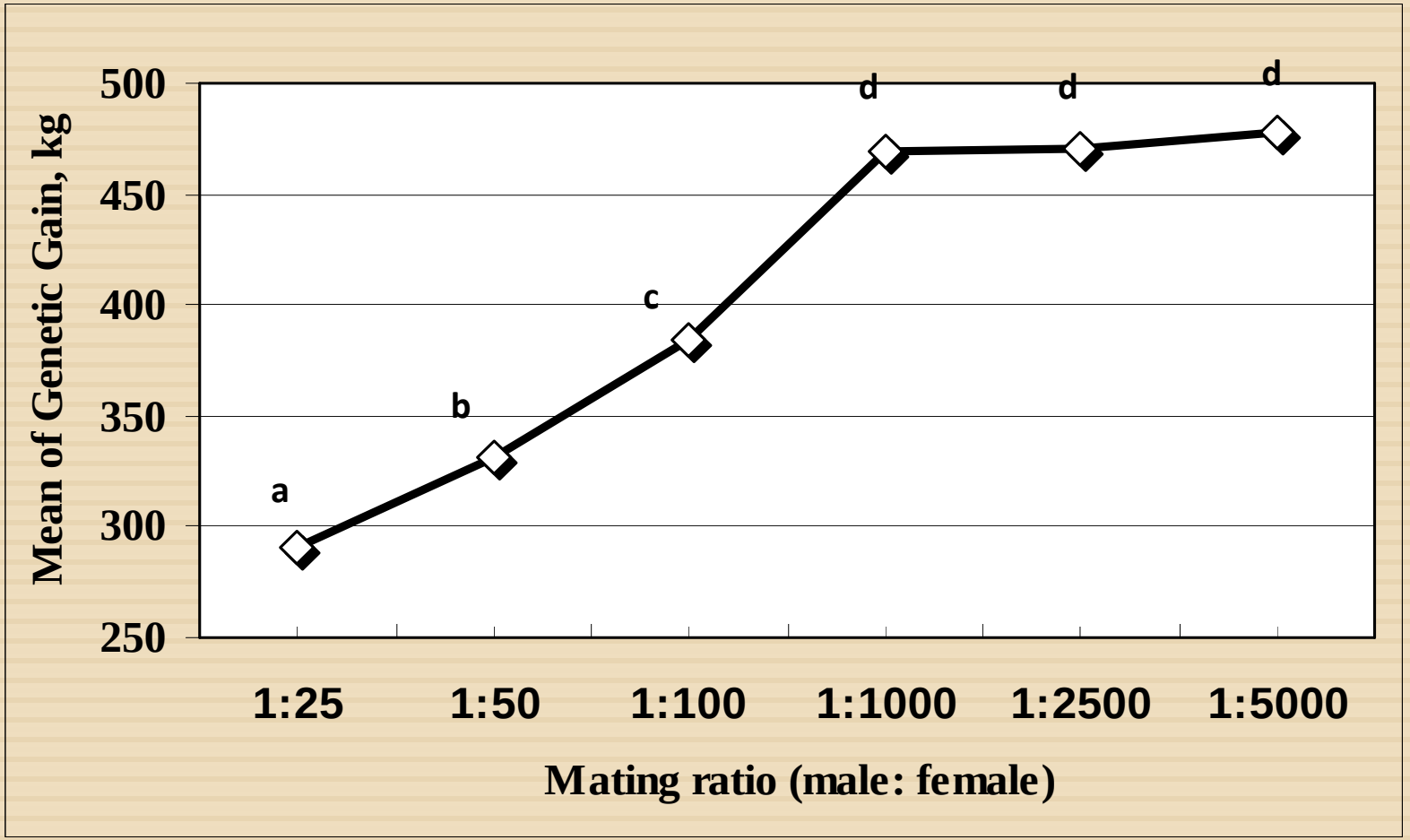
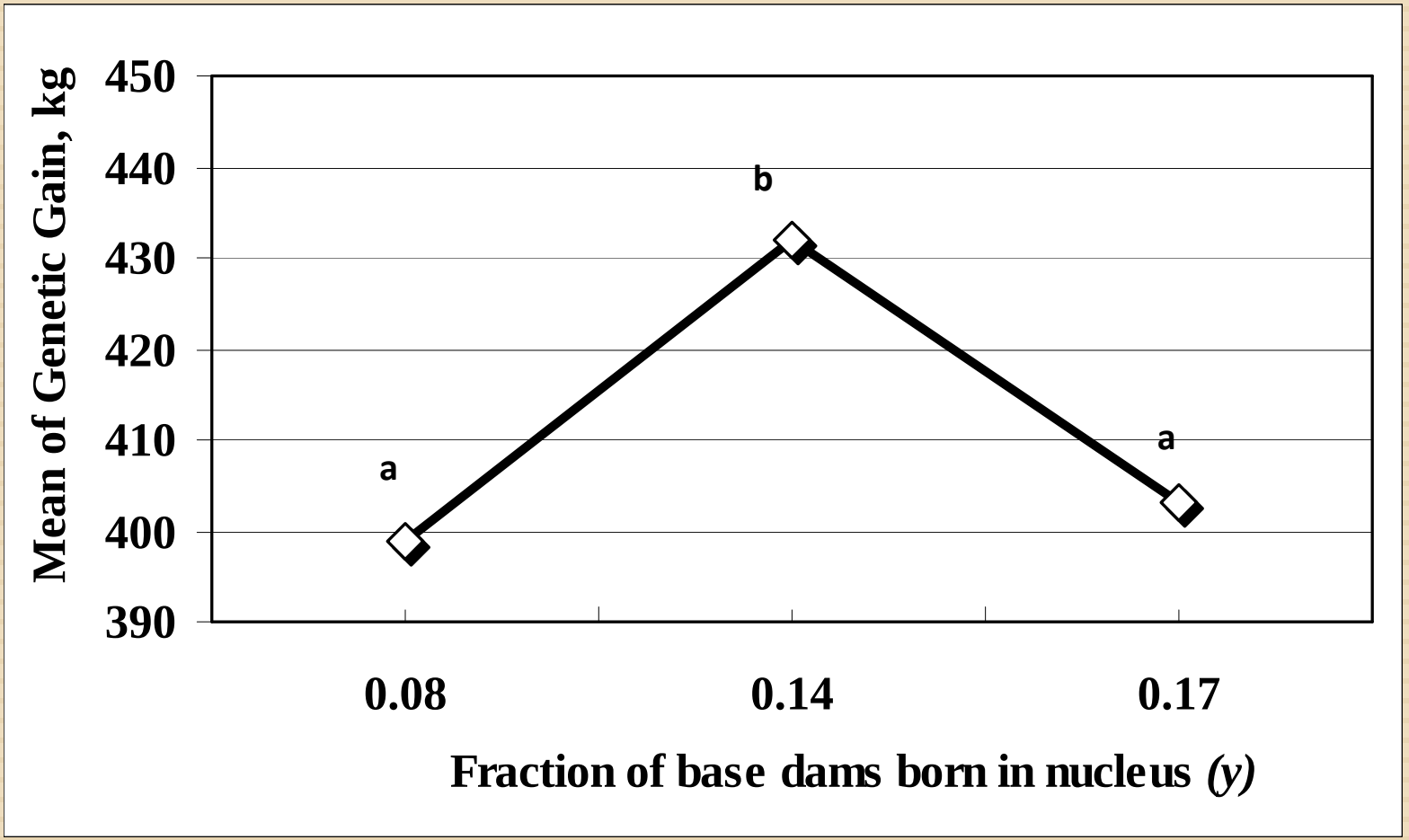
[a,b,c,d]Means with different letters differ significantly ($P<0.05$).

Change of genetic gain means by changing fraction of base sires born in nucleus (*w*).



[a,b,c,d]Means with different letters differ significantly ($P<0.05$).

Change of genetic gain means by changing different mating ratios (*MR*).



[a,b]Means with different letters differ significantly ($P<0.05$).

Change of genetic gain means by changing fraction of base dams born in nucleus (*y*).

CONCLUSION

- **The open nucleus breeding scheme offers a suitable practical procedure for producing and disseminating buffalo bulls of known breeding values.**
- **Applying ONBS for many generations of selection could accelerate the rate of genetic gain of milk production in buffalo and increase the average milk yield by 15% in *G1* to 26% in *G4*.**

CONCLUSION

- **It is recommended to take into account mating ratios when applying ONBS with the combinations of *z (population size)* and *p* (nucleus size) which affect *a* (proportion of all males born used as sires) and *w* (fraction of base sires born in nucleus).**

Thank you