

ALIMENTATION AGRICULTURE ENVIRONNEMENT

A resource allocation approach to combine selection and management within the herd environment

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Context of production improvement

Selection solely on production traits:

SPECTACULAR PROGRESS

... with simultaneously low environmental limitation



Context of production improvement The future

Herd environments (E) are changing with probably increasing variations in the future



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Breeding programs still select genotypes (G) in non-limiting environment to demonstrate a high level of phenotypic performance (P)



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Breeding programs still select genotypes (G) in non-limiting environment to demonstrate a high level of phenotypic performance (P)

Risk of MISMATCH between G and E



Mapping the problem

Between generations

Within-life

Population

4 Mapping the problem 4







5 Mapping the problem 5













7 Mapping the problem $taking advantage of G \times E$







Describe the animal to explore the long-term consequences of selection × management in a herd





Describe the animal to explore the long-term consequences of selection × management in a herd





General approach







□ Resource allocation theory

□ The herd environment system

- 1. Case study
- 2. System approach
- 3. Model description

Gamma Focus

- 1. Management effect on within-life performance
- 2. Long term consequences of selection × management

Discussion





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11 The resource allocation principle



van Noordwijk & de Jong, 1986

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van Noordwijk & de Jong, 1986



The resource allocation application

e.g. selection for P_1



Beilhartz et al., 1993,



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Mapping the problem 13 taking advantage of G × E







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The herd environment system approach

	Whole-life (generational)	Within-life
HERD	Selection of "robust" animals	Management of extended lactation
ANIMAL	Heritable component of allocation	Expression of allocation priorities

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Focus 1

The herd environment system approach

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Focus 2





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The herd environment system model overview



Selection Index = $(W_1 \times P_1) + (W_2 \times P_2) + (W_3 \times P_3) + \dots$



The herd environment system herd simulation














The herd environment system animal model assumptions

Body Resource reserves availabilty Simplifying assumptions: K **Genetic variation** only d assumed at the level Deposition p – p) of resource allocation to Pregnancy body reserves deposition (d_0) and Lactation – g) g lactation (l_0)

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Growth

Survival



















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Previous studies showed a " 2nd peak " of lactation when its length is extended for non-pregnant goats (Linzell, 1973, Chastin et al., 2001, Salama et al., 2005)

 \rightarrow What about body weight and intake?

 \rightarrow Do they vary in the same way than during the peak phase in normal lactation?

Design of an experimental study to compare "normal"





0

7 63 133 203 273 343 7 63 133 203 273 343 Time after parturition (days)

2 "normal" successives lactations







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and "extended" lactations





extended lactation disrupts the opposition phase between milk and weight dynamics which normaly occurs



2 main new features of extended lactation included in the model and calibrated with data from the experimental study:

1. a transient increase in **resource acquisition** at about 330 days after parturition

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2. almost simultaneously an increase in **resource allocation expression** towards body reserves deposition (d) and towards lactation (l)

Management of extended lactation integration in the model







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Consequences of selection × management simulation study

Selected individuals should have: High production $W_{Milk} = 1$ Successful reproduction $W_{PREG} = 1$ (pregnancy status) $-\frac{1}{\sqrt{1-1}}$

Random resource availability





Consequences of selection × management simulation study

Selected individuals should have: High production $W_{Milk} = 1$ Successful reproduction $W_{PREG} = 1$ (pregnancy status)

Random resource availability

Giving E, animals selected over years are deemed to be robust

→ test of an increasing value of $W_{A\sigma e}$





Consequences of selection × management simulation study

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Configuration:

Selection during 40 years

Herd size = 500



Consequences of selection × management results: herd rates

+

Survival rate, %



36 Consequences of selection × management results: herd rates



with increasing proportion of extended lactation

37 Consequences of selection × management results: herd rates



with increasing proportion of extended lactation









High proportion of extended lactation
➔ non-linear effects on milk and condition selection responses

Consequences of selection × management 38



Consequences of selection × management results: allocation type I



Consequences of selection × management results: allocation type I



Consequences of selection × management results: resource allocation



Consequences of selection × management results: allocation type II



Consequences of selection × management results: resource allocation



Consequences of selection × management results: allocation type III



Consequences of selection × management results: allocation type III


Consequences of selection × management results: resource allocation







confirms Beilhartz et al., 1993, van der Waaij, 2004

Consequences of selection × management overall result: trade-off



in lines with suggestion of Kolver et al., 2009

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General approach

















The relationship between competing traits is manageable



Win-win situation demonstrates a synergy between selection and management effects



The relationship between competing traits is manageable



Win-win situation demonstrates a synergy between selection and management effects

Not a single road to production improvement

→ exploit innate biological capacities to deal with variable resource provision









Discussion framework

G × E not a result *per se* but a multi-level process that involves the farm manager



Only a proof-of-principle



Discussion framework

G × E not a result *per se* but a multi-level process that involves the farm manager



Only a proof-of-principle

Limitations:

G: crude selection index, random mating, closed herd E: 'narrow' nutrition, crude intake, simplified reproduction management

Evaluation of the resource allocation hierarchy











Towards a generic animal model

→ Estimation of the genetic parameters of the generational component of allocation





Towards a generic animal model

→ Estimation of the genetic parameters of the generational component of allocation

Towards taking advantage of $G \times E$

 \rightarrow Role of the manager in the herd environment





Challenging context opens a bright future for production improvement, if we focus on

INTERACTIONS

Herd Selection – Management

Animal Resource acquisition – Resource allocation

AND SYNERGY OF METHODS

Modelling – Experimentation

Thank you for your attention

