ALPACA GENETIC IMPROVEMENT PROGRAM OF THE CAYLLOMA PROVINCE - PROMEGE

Carlos Pacheco Murillo
desco
Southern Regional Program
36° ICAR Session
Niagara Falls 16 – 20 June 2008

COLLABORATION

- Carlo Renieri y Alessandro Valbonesi
  - SDA – UNIVERSITA’ DEGLI STUDI DI CAMERINO – Italy
- Eduardo Frank – Michel Hick
  - UCC - SUPPRAD - Argentina
- Marco ANTONINI
  - ENEA - Italy
Various Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Partnership</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELOS FINOS</td>
<td>EU DG1 Italy, Spain, Argentina</td>
<td>1992-1995</td>
</tr>
<tr>
<td>SUPREME</td>
<td>EU DGXII Italy, Germany, France, U.K., Argentina, Bolivia, Chile, Ecuador, Peru</td>
<td>1996-2001</td>
</tr>
<tr>
<td>DECAMA</td>
<td>EU INCO DEV Italy, Germany, Argentina, Bolivia, Peru</td>
<td>2002-2006</td>
</tr>
</tbody>
</table>

“PROMEGE”
ALPACA GENETIC IMPROVEMENT PROGRAM OF THE CAYLLOMA PROVINCE
BACKGROUND

- 1985 desco - Rural Development Colca Canyon Program
- 1996 desco- Center for Development of Alpacas-Toccra
- 1997 EU - INCO Program (ended in 2001)
- 1998 desco - Supreme Program: Formula Selection Plan (Gonzales and Renieri)
- 2003 – AGE Home Selection Program: Australia & New Zealand
- 2005 – ITALPACA Home Selection Program: Italy
- 2005 – Promega Start Selection Program: Caylloma – Arequipa
- 2007 - desco becomes a member of ICAR (International Committee of Animal Recording)
DEMOROGPHIC PARAMETERS OF THE ALPACA POPULATION IN CAYLLOMA

- 200,000 Alpacas
- 90% Huacaya
- 10% Suri
- 60% White
- 40% Color
SPECIFIC OBJECTIVES OF PRE-SELECTION

On the TOCCRA Population was discarded animals that have:

- Morphological congenital defects
- Unknown features of specific race.
- Spotted alpacas
- Non-uniform color patterns
- Undefined fleece

SPECIFIC OBJECTIVES OF SELECTION

- Fleece Type:
  - HUACAYA
  - SURI
- Solid Color:
  - BLACK OR WHITE
  - BROWN
- Reduction of Fiber Diameter (fineness)
- Reduction of Coefficient of variation (CV) of Fiber Diameter
- Increase of Fleece Weight
SELECTION CRITERIA

- Direct observation of animals at birth, by fleece type and color
- Produced fiber weight in the first shearing at age one with a confidence interval of ± 2 months (Antonini et al 2004)
- Average fiber diameter and the coefficient of variation of fiber obtained during the first shearing through a sample on the left side of the alpaca

Genetic Parameters
Quantitative Features

- Fleece weight
- Fineness of fiber (diameter)
- Coefficient of Variation of the Fiber Diameter

Tab. 1. Alpacas (n = 288)

<table>
<thead>
<tr>
<th>Color</th>
<th>Huacaya (255)</th>
<th>Suri (33)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>White</td>
<td>87</td>
<td>98</td>
</tr>
<tr>
<td>Brown</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td>Black</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>115</td>
<td>140</td>
</tr>
</tbody>
</table>

+ 5 animals in other colors (Gray, LF)
Total = 29
### Statistical Difference between Variables

<table>
<thead>
<tr>
<th>Factors</th>
<th>TYPE</th>
<th>SEX</th>
<th>Birth year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Huacaya</td>
<td>Male</td>
<td>2005</td>
</tr>
<tr>
<td></td>
<td>Suri</td>
<td>Female</td>
<td>2006</td>
</tr>
<tr>
<td>Variable</td>
<td>F</td>
<td>Sig.</td>
<td>F</td>
</tr>
<tr>
<td>Fleece Weight</td>
<td>0.322</td>
<td>0.571</td>
<td>0.28</td>
</tr>
<tr>
<td>Fiber Diameter</td>
<td>2.205</td>
<td>0.139</td>
<td>0.008</td>
</tr>
<tr>
<td>Coefficient of Variation</td>
<td>7.939</td>
<td><strong>0.005</strong></td>
<td>0.057</td>
</tr>
</tbody>
</table>

### Uses of the Statistical Program

- **Multiple-Trait Animal Model**
- **MTDFREML (Multiple Trait Derivative-Free Restricted Maximum Likelihood)** (“Agricultural Research Service – United States Department of Agriculture”)
- **Excel.**
### Heritability and Correlations

<table>
<thead>
<tr>
<th></th>
<th>Fleece Weight</th>
<th>Fiber Diameter</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fleece Weight</td>
<td>0.84</td>
<td>0.230*</td>
<td>0.377*</td>
</tr>
<tr>
<td>Fiber Diameter</td>
<td>0.179*</td>
<td>0.32</td>
<td>0.324*</td>
</tr>
<tr>
<td>Coefficient of</td>
<td>0.091</td>
<td>0.124*</td>
<td>0.46</td>
</tr>
<tr>
<td>Variation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

f P ≤ 0.001

### SI - Selection Index

<table>
<thead>
<tr>
<th></th>
<th>Fleece Weight</th>
<th>Fiber Diameter</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>variable Weight</td>
<td>0.10</td>
<td>0.50</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Genetic Index: General Data

- 293 animals
- 154 positive indexes (53%)
- Reliability
  Variation = 50.3% - 78.3%
  Average = 73.3
  126 animals ≥ 73.3%

HUACAYA n. = 255

<table>
<thead>
<tr>
<th></th>
<th>♀ (115)</th>
<th>♂ (140)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>White</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>Brown</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Black</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Overall</td>
<td>65</td>
<td>50</td>
</tr>
</tbody>
</table>
SURI (n = 33)

<table>
<thead>
<tr>
<th></th>
<th>♀ (12)</th>
<th>♂ (21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>White</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Brown</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Black</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Overall</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Selection Scheme

2 SCHEMES:

- **Open Nucleo**
  - HUACAYA WHITE
  - SURI WHITE

- **Cooperation Nucleo**
  - HUCAYA BROWN
Benefits to Schedule the Open Nucleo

- Best population stratification
- Reduction of the number of control animals
- Good intensity selection
- Election of elite group

Diagram Selection Scheme

- Formation of Animals Families
- Circular Mating Between Families
- Controlled Breeding Season
- Players Males
- Breedings

Breeders base
MULTIPLIERS
Nucleo
Nucleo Families Structure

Alpaca huacaya white (9)
Alpaca huacaya brown (4)
Alpaca suri white (4)

Reproductive Management of Open Nucleo

CIRCULAR MATING SYSTEM
(Wright, 1921, 1931: Kimura and Crown, 1963)

“Maximum Avoidance of Inbreeding”

- $N_e = N$
- Avoid close consanguinity (Current inbreeding)
HALF SIB CIRCULAR MATING SYSTEM

Subdivide the nucleo units (families)

- Equalize the number of families (EFS = Equalization of family size);
- To reduce the fluctuation of the number of families across generations

CIRCULAR SCHEME

- The families form a circle alternatively
- The breeding season is between distant animals in terms of inbreeding
- The males in the family breeders pass to the right family
FAMILIES

- Same race
- Same color
- Children to cousins in the first degree
- Average of 20 to 30 females
Reproductive Reference Parameter

- Male to female 15

Using males with a replacement:

- Nucleo: biannual
- Multipliers every three years
- Average females fertility above 70%

Intensity Selection of the Nucleo

NEGATIVE ALPACA
- Males → slaughter
- Females → outside the selection plan or slaughter

POSITIVE ALPACA
- Male
- 10% - 20% Nucleus
- 80% - 90% → Multipliers
- Female
- 50% Nucleus
- 50% → Multiples
Criteria for Choosing Multipliers

- Stud Book
- Performance CONTROL
- Programmated Mates

CONCLUSION

- The selection plan achieves a greater genetic progress since it enables the implementation of scheduled breeding season between animals with positive selection index.
- The plan for selecting the Nucelo can be disseminated in a context of “Campesinos” systems.
- The genetic improvement program must set their objectives, geographical areas, populations and priorities to prevent the occurrence of undesirable effects on its target population.
Thanks