**Method of analysis**

Daughter Yield Deviations were standardized within country. This was done to remove the effect of different unit and base for age adjustment definition in each country. The standardization factor was calculated as the square root of the product of the standard deviations of bull national proof (estimated transmitting ability) and DYD. This would give an approximation of half the true genetic standard deviation. Pertinent theory is included in Appendix II. Standardization factors were calculated within birth year and then pooled across years. Within year standard deviations of DYD and national proofs for different countries are shown in Appendix III. In each case, only bulls initially sampled in the corresponding country, born after 1970, which met the editing criteria were considered; this was done because before 1975 (approximate birth year of first artificial insemination daughters of the base bulls) there was no official progeny testing in the European countries. Table 4 includes all standardization factors that were calculated, by country and trait.

TABLE 4: Standardization factors, base for age adjustment in months (BA), number of lactations considered (NL), and units of expression in each country; values are not comparable across country.

| Country | Milk | Fat yield | Protein yield | BA | NL | Unit |
|---|---|---|---|---|---|---|
| ITA | 271 | 9.63 | 7.85 | 84 | All | ITA-kg |
| FRA | 323 | 11.49 | 8.48 | 72 | 3 | FRA-kg |
| NLD | 234 | 8.90 | 6.43 | 24 | 3 | NLD-kg |
| DEU | 234 | 9.34 | 6.51 | 30,42,54* | 3 | DEU-kg |
| USA | 664 | 22.83 | 18.38 | 78 | 5 | USA-lb |

* separate BA for each lactation

Units in Table 4 are pounds in USA and kilograms in all other countries; kilograms, however, are not comparable among countries because they depend on the definition of base for age adjustment which differs from country to country. Pairwise ratios correspond to conversion slopes between estimated transmitting abilities in different countries (e.g. ITA/USA=.41, .42, and .43, for milk, fat, and protein yield, respectively).

Standardization of DYD was achieved by dividing each DYD within country by the appropriate standardization factor (from Table 4). Standardized DYD for yield traits were analyzed across country by Model 2:

$$Y = Xc + ZQg + Zs + e \qquad [2]$$

where:

| | |
|---|---|
| Y: | standardized DYD |
| c: | fixed effect of country of evaluation |
| g: | fixed effect of genetic group |
| s: | random effect of bull within genetic group |
| e: | random residual effect |
| X, Z, Q: | incidence matrices |

Genetic groups were defined by birth year and population of origin. Eight populations of origin were considered: ITA, FRA, NLD, DEU, USA, CAN, GBR, and OTHERS. Since CAN and GBR had many bulls in the pedigree data file, they were considered separately, although these two countries did not participate directly with own evaluation files. Fifty eight groups were formed. The first group solution was set to zero. The same model was used for ALP and FSP, for all yield traits. All known male relationships among bulls, within and across countries, were utilized. After solving the mixed model equations, EC proofs were formed by adding group and bull solutions. Since standardized DYD had been used as dependent variables, EC proofs were unitless.

Milk component concentration traits (fat % and protein %) were evaluated indirectly according to Model 3:

$$P\% = \left\{ \frac{P + PA}{M + MA} - \frac{PA}{MA} \right\} * 100 \qquad [3]$$

where:

| | | |
|---|---|---|
| P% | : | Estimated transmitting ability of concentration trait (fat%, protein %) |
| P | : | Estimated transmitting ability of component yield trait (fat, protein) |
| M | : | Estimated transmitting ability of milk |
| PA | : | Phenotypic mean of component yield trait of base animals |
| MA | : | Phenotypic mean of milk yield of base animals |

Adjusted phenotypic means were provided by each country and are shown in Table 5.

TABLE 5: Adjusted phenotypic means of base animals; values expressed in kg equivalent to each country and are not comparable across country.

| Country | Milk | Fat yield | Protein yield | Fat % | Protein % |
|---|---|---|---|---|---|
| ITA | 7346 | 259 | 225 | 3.52 | 3.07 |
| FRA | 7100[1] | 270[1] | 210[1 2] | 3.80[1] | 2.96[1 2] |
| NLD | 5571 | 245 | 187 | 4.40 | 3.36 |
| DEU | 6654 | 280 | 222 | 4.21 | 3.34 |

[1] Approximate

[2] True Protein=.95*(Crude Protein)