

## **Fitting milk production curves through nonlinear mixed models**

Monica Piccardi<sup>1</sup>, Raúl Macchiavelli<sup>2</sup>, Ariel Capitaine Funes<sup>3</sup>, Gabriel A. Bó<sup>4,5</sup>, Mónica Balzarini<sup>1,6\*</sup>

<sup>1</sup> Cátedra de Estadística y Biometría de la Facultad de Ciencias Agropecuarias de la Universidad Nacional de Córdoba.

<sup>2</sup> Universidad de Puerto Rico (Mayagüez).

<sup>3</sup> DAIRYTECH S.R.L., Santa Fe, Argentina

<sup>4</sup> Instituto de Reproducción Animal Córdoba (IRAC), Paraje Pozo del Tigre, Zona Rural Est. General Paz, (5145) Córdoba, Argentina.

<sup>5</sup> Instituto de Ciencias Básicas y Aplicadas, Carrera de Medicina Veterinaria, Universidad Nacional de Villa María, Villa del Rosario, Córdoba, Argentina.

<sup>6</sup> Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)

Short title: **Fitting milk production curves**

\* Correspondence: Av. Valparaiso S/N

Córdoba

Argentina

C.P.: 5000

phone (54) 351 4334103/05/16/17/18

*E-mail:* [mbalzari@gmail.com](mailto:mbalzari@gmail.com).

**Summary**

The aim of this work was to fit and compare three non-linear models (Wood, Milkbot and diphasic) to model lactation curves from two approaches: (with and without cow random effect). Knowing the behavior of lactation curves is critical for decision-making in a dairy farm. Knowledge of the model of milk production progress along each lactation is necessary not only at the mean population level (dairy farm), but also at individual level (cow-lactation). The fits were made in a group of high production and reproduction dairy farms; in first and third lactations in cool seasons. A total of 2,167 complete lactations were involved, of which 984 were first-lactations and the remaining ones, third lactations (19,382 milk yield tests). PROC NLMIXED in SAS was used to make the fits and estimate the model parameters. The diphasic model resulted to be computationally complex and barely practical. Regarding the classical Wood and MilkBot models, although the information criteria suggest the selection of MilkBot, the differences in the improvement of estimation of production indicators do not show a significant improvement. The Wood model was found to be a good option for fitting the expected value of lactation curves. Furthermore, the three models fitted better when the subject (cow) random effect was considered, which is related to magnitude of production. The random effect improved the predictive potential of the models, but it did not have a significant effect on the production indicators derived from the lactation curves, such as milk yield and days in milk to peak.