

A comparison of collinearity mitigation techniques used in predicting BLUP breeding values and genetic gains over generations

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Abstract

Collinearity potentially has a negative impact on the prediction of genetic gains in tree breeding programs. This study investigated the reliability and impact of best linear unbiased prediction (BLUP) using various collinearity mitigation techniques and of two computational numerical precisions on the genetic gains in breeding populations. Multiple-trait, multiple-trial BLUP selection scenarios were run on *Eucalyptus grandis* (F_1 , F_2 and F_3) and *Pinus patula* (F_1 and F_2) data, comparing predicted breeding values of parents (forward prediction) with those realised in progeny (backward prediction of parents). Numeric precision had an impact on intergenerational correlations of BLUPs of some scenarios, indicating that it may not always be optimal to use higher precision when there is collinearity in the data. The relative difference in genetic gains between techniques varied by up to 0.38 standard deviation units in the less-stable pine population. This highlights the potentially large impact that instability can have on the efficiency of a breeding programme. BLUP performed close to expected in the relatively stable (less collinear) population (eucalypt F_1), and performed poorly in the other two populations. In the unstable pine data, some of the techniques resulted in improved intergenerational correlations coming in line with expected performance. This study indicates that BLUP can perform as expected and also confirms the potential problem of instability and consequences thereof. BLUP users should examine the nature of the population of predicted values and should these be outside expectation, various mitigation techniques should be explored.

Keywords

- BLUP,
- breeding values,
- collinearity,
- multigenerational,
- [realised genetic gains](#)

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