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The value of genetic information in selecting dairy replacements

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Abstract

The objective of this study was to empirically determine the economic value of genetic information in the selection of dairy replacements, and assess whether this value was sufficient to prompt producers to select replacements on this basis. The data set consisted of 1982 Michigan Holstein replacements in 115 herds. Each herd had a minimum of 10 replacements that were born in the last 6 months of 1992 and calved within the last 6 months of 1994. The data for each replacement included the estimated breeding value (EBV) for milk at the beginning and end of the rearing period, and the estimated lifetime profit corrected for the opportunity cost of postponed replacement (ELPCOC). The replacement selection decision for a profit-maximizing dairy producer selecting 70 or 80% of the replacements was modeled. We modeled three methods of selection: genetic, random and ex poste. Genetic selection was evaluated using the EBV milk available at the beginning or end of the rearing period. For each herd, the profit associated with each of the three methods of selection was simulated. The value of the genetic information and perfect information were the differences in herd profits of genetic selection and ex poste selection relative to random selection, respectively. The difference in value of the genetic information between the end of the rearing period and the beginning of the rearing period was the increase in value of the genetic information due to updating. The value of information was calculated as the average herd profit per replacement. The value of the genetic information ranged from $ 22/replacement to $ 30/replacement and was statistically greater than zero at a 95% confidence level. It is unclear whether this value is sufficient

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to prompt producers to select replacements on the basis of EBV milk as has been recommended. The negative value of EBV milk (from the end of the rearing period when selecting 80% of the replacements) for 32 herds was consistent with the noisiness of the genetic estimates as messages of ELPCOC. The increased value of the genetic information due to updating was approximately $ 5/replacement. This increased value is likely insufficient to warrant delaying replacement selection decisions solely to obtain the updated information. The value of EBV milk was approximately $ 4/replacement higher when selecting 70% of the replacements versus 80%. The genetic information captured between 15% (selecting 70% at the beginning of the rearing period) and 20% (selecting 80% at the end of the rearing period) of the value of perfect information.

Keywords: Genetics; Information noise; Message updating; Replacement livestock selection; Value of information

1. Introduction

Management of replacements is an element of dairy cattle production medicine programs. The goal of replacement management is to economically supply a sufficient number of animals to replace culled cows. Dairy cow culling decisions compare the profit of a potential replacement with that of a cow currently in the herd. The cow is replaced if the replacement is expected to be more profitable. Although there exists a considerable body of literature on culling decisions in dairy herds, it focuses almost exclusively on the dairy cows, not the replacements. Areas of study have included the effects of disease or production on cow culling, and the optimal cow culling rates to maximize profit or milk production. In contrast, replacements have received little attention in the dairy culling literature.

There are three motivations for considering a method of selecting replacements in the dairy cattle culling decision. First, application of standard capital asset replacement theory (Perrin, 1972) dictates that the more profitable the replacement relative to the cow the higher the optimal culling rate. Thus, the culling rate is a function of both the cow and the replacement. Second, although replacement selection based on the estimated breeding value (EBV) for milk has theoretical justification (Henderson, 1963) and has been recommended (Heinrichs and Swartz, 1990), empirical support for replacement selection on this basis is lacking. Milk EBV is an estimate of a replacement's genetic merit for milk production. Thirdly, the need for a method of replacement selection is predicated on the optimal dairy herd replacement rate literature. Among herds maintaining a constant size, replacement rates can reach greater than 40% in herds utilizing all their replacements. Yet, the consensus within the literature is that selecting only a proportion of the replacements to enter the cow herd to result in annual replacement of 20–30% of the cows maximizes producer profit (Radke and Lloyd, 2000). The excess replacements are sold to other herds. This consensus is compelling because the studies employed different assumptions, different analytical techniques, and different economic conditions representative of a number of countries (i.e., USA, England, Ireland, Netherlands, Canada). However, assumptions of random (i.e., no use of genetic information) selection of replacements, constant herd size, no seasonal effects on reproduction and production, and risk neutrality