ECONOMIC RESPONSES AND RISK FROM USE OF SELECTED HOLSTEIN SIRES IN ITALY, MEXICO, THE NETHERLANDS AND USA

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SUMMARY

Economic responses were estimated from stochastically simulated dairy herds using genetic evaluations of proven or young US Holstein sires available in January of 1996. Conversion equations, economic indices, and genetic, economic and managerial parameters for milk, fat and protein production in Italy, The Netherlands and the United States, and for milk yield in Mexico were used in calculation of sire profit and response for each country. Discounted cumulative revenue and semen costs to planning horizons of 10 and 20 years from a continuous selection model were used to estimate profit. Proven and young sires selected on profit or the option of using 20 randomly chosen young sires at low semen cost per dose were evaluated. Results were obtained from 1000 replicates for combinations of type and number of sires selected per year and cow herd size in each country. Results were evaluated with three degrees of risk aversion; risk neutral (profit), moderate risk aversion (LCL95) (lower 95% confidence limit for profit), and high risk aversion (utility) (profit -.06*variance of profit). Use of a 10-year planning horizon, or selection in countries with lower absolute economic responses, would favor use of randomly chosen young sires. Use of selected proven and young sires was generally superior to use of randomly chosen young sires for profit and LCL95 at year 20 for all combinations studied, but was inferior for utility at year 10. Optimum decisions were different for different countries, planning horizons and economic and management conditions. Effect of herd size on the ranking of strategies was small.

Keywords: Dairy cattle, international sire selection, profit, risk, economic indices.

INTRODUCTION

Maximization of functions involving profit and variance of profit are options to increase economic response to dairy sire selection by accounting for the economic worth of genetic response, semen costs and risk involved in breeding decisions (Schneeberger et al. 1982b; Leitch et al. 1994). Risk could be defined as a measure of the probability that profit may fall below some unacceptable low level.

In the last 25 years, substantial interchange of Holstein semen has taken place internationally (Powell and Sieber 1994a, 1994b) and reliable systems to transform breeding values predicted in different countries have been developed by INTERBULL (International Bull Evaluation Service) with the MACE (multitrait across country evaluation) procedure (Powell 1995).

The objective of this study was to evaluate the influence of several factors on economic responses to

selection with differing degree of risk aversion such as profit (benefit-cost), lower 95% confidence limit of profit (LCL95), and utility (profit-.06*variance of profit) from use of Holstein sires evaluated in USA and used in Italy, Mexico, The Netherlands and USA.

MATERIALS AND METHODS

A stochastic simulation model was used with continuous selection to obtain cumulative phenotypic change in profit to years 10 and 20. Sampling from a population of sires similar to those available in USA for a period beginning in 1996 was assumed. The average breeding value of the sires was updated each year from milk, fat and protein genetic trend evaluations available from the USDA for the period 1989-1993.

Average indices and other input parameters for sires were obtained for proven sires available from the January 1996 USDA sire summary. A total of 405 sires from the main eight semen companies in the U.S. were included in the study. A total of 93 young sires with parent average indices for milk, fat and protein and semen price, from three companies also were included. Profit indices used as selection criteria to maximize expected profit were found by weighting the economic index and semen price. Profit index was: PROFIN=w_1*dollar index-w_2*semen price. The weights for the economic index (w_1) and for semen price (w_2) were obtained for each country from cumulative benefit and cost to year 20 from results of the simulation model. Number of sires selected were 1, 2, 3, 5, 10 and 20.

Net benefit was calculated from cumulative economic response multiplied by the net income over feed costs (Holmann et al. 1990; VanRaden et al. 1993). Both benefit and cost were discounted to account for time (Hill 1971). Profit, and variance of profit were calculated at years 10 and 20.

Combinations of options involved Italy, Mexico, The Netherlands and USA. Herd sizes were 30, 100, 200, 500 and 1000 for USA; 30, 100, 200 and 500 for Mexico; and 30, 100 and 200 for Italy and The Netherlands. For each combination, proven or young sires were selected, or a random sample of 20 young sires with low semen cost (US$2.00) was used. Response variables were profit (risk neutral decision), LCL95 (risk averse) and utility (high degree of risk aversion) (Anderson et al. 1977; Schneeberger et al. 1981, 1982b; Leitch et al. 1994). All options were evaluated based on 1000 replicates.

RESULTS AND DISCUSSION

Strategies for combinations of country, herd size, and type of sire that maximize response variables are shown in Table 1.

The optimum number of sires is smaller as less emphasis is given to variation of response, with important increases in number of sires for utility vs. profit or LCL95. In all countries, the optimum numbers of sires associated with LCL95 and utility, were greater for 10 than for 20-year planning horizons, but the increases in relative terms were greater for The Netherlands and Mexico than for Italy and USA.

Table 1. Optimum numbers of sires by type for combinations of herd size and country[1]

Herd size	Type of sire	Country	Planning horizon: 10 years, Evaluation criterion: Profit	10 years, LCL95	10 years, Utility	20 years, Profit	20 years, LCL95	20 years, Utility
30	Proven	Italy	1	1	20	1	1	10
30	Young		5	5	20	1	2	20
100	Proven		1	1	20	1	1	5
100	Young		1	5	20	1	5	20
200	Proven		1	1	20	1	1	10
200	Young		2	5	20	2	5	10
30	Proven	Mexico	1	3	20	1	3	5
30	Young		1	2	20	1	2	20
100	Proven		1	3	20	1	3	5
100	Young		1	10	20	1	2	10
200	Proven		1	3	10	1	3	10
200	Young		1	5	20	1	5	20
500	Proven		1	3	20	1	3	10
500	Young		1	20	20	1	5	20
30	Proven	The Netherlands	1	5	20	1	1	10
30	Young		1	2	20	1	2	5
100	Proven		1	3	20	1	1	20
100	Young		1	5	20	1	5	5
200	Proven		1	5	20	1	1	5
200	Young		1	10	20	1	3	10
30	Proven	USA	1	1	20	1	1	20
30	Young		2	2	20	1	2	20
100	Proven		1	2	20	1	2	10
100	Young		1	5	20	1	10	10
200	Proven		1	2	20	1	2	10
200	Young		1	5	20	1	5	20
500	Proven		1	2	20	1	2	10
500	Young		2	10	20	1	10	10
1000	Proven		1	2	20	1	2	10
1000	Young		1	10	20	1	10	10

[1]For options underlined, using 20 randomly selected young sires was the best strategy.

In all cases, optimum number of sires for maximizing utility in countries with high responses was greater than for countries with lower economic responses. This result indicates the sensitivity of

utility to changes in variance of profit. Given the subjective nature of the weight for variance, high weights for the variance of profit could be easily chosen, which may have a negative impact on the final goal of maximizing profit and keep risk under control. Klieve, Kinghorn and Barwick (1993) found that optimum weights for the standard deviation of profit are in the range ± .5 to ± 1.5. If this criterion is adopted, our results indicates that a weight of -.06 for the variance of profit resulted in values greater than 1.5 as a weight for the standard deviation of profit for all combination studied.

Trends for LCL95 are very different from those for utility, with optimum number of sires more similar to those for profit. As expected, optimum numbers of young sires were larger than for proven sires to optimise LCL95 and utility.

A 10-year planning horizon or selection in countries with lower absolute responses, favor the option of using low-cost, randomly chosen young sires to maximize utility. Use of selected proven and young sires was superior to use of randomly chosen young sires for profit and LCL95 at year 20 in all combinations studied, but was inferior for utility at year 10. Effect of herd size on optimum decisions was small.

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