

Potential Gain from Insertion of Major Genes into Dairy Cattle

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Abstract

Transgenesis could be used to enhance genetic improvement of dairy cattle. Cost-benefit analyses for a mastitis resistance, somatotropin, and a major production gene linked to a genetic defect indicate that economic gains are possible. High cost of producing transgenes can be recovered from the dairy industry when additive or dominant genes are introduced into commercial populations via AI sires with royalties collected on founder sires and sons. Progeny test of founder transgenic sires requires larger numbers of daughters and test for recessive effects and Mendelian transmission to offspring. Some potentially useful genes have already been isolated and cloned (growth hormone, casein, and mastitis resistance genes), but transgenesis cannot be applied to commercial populations before serious deficiencies of the technology are resolved. Ways to control reliably the time and location of gene expression and the site of insertion must be found to avoid deleterious side effects, undue complications of selection programs, and initially very slow increase in gene frequency. Introducing transgenes may require quite large populations because to obtain one successful transgenic sire, 2 to 12 transgenic bulls must be tested with at least 200 daughters each. With highly controllable gene expression, transgenes may permit temporary increases in rate of genetic progress for traits currently of primary importance and, in particular, achieve improvements where existing genetic variation does not allow sufficient change (mastitis resistance, milk composition) and where desirable genes (animal welfare, e.g., polled gene) cannot be selected for because they are not carried by individuals of high genetic merit.

Key words: major genes; gene transfer; dairy cattle improvement