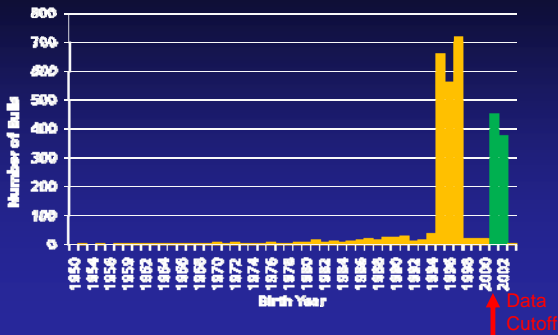


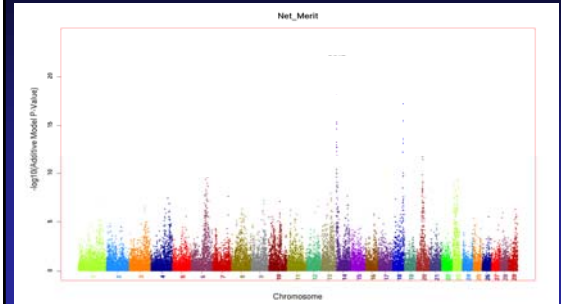




# Srsx@wlrq#f#wxfwuh#J Krowhlg



# J hqrp lf#Suhg lfwrq



# J hqrp h#Vhdfwrq

**No bull: genes for better milk**

The US Department of Agriculture (USDA) launched a service that allows dairy cattle breeders to double their chances of selecting the best bulls to sire milk-producing cows.

"This is the future of animal breeding," says Ingeborg Ruvik, a veterinary surgeon at Kansas State University in Manhattan. "For a decade, breeders who want to locate the best bull have the animals' names tested for its DNA, looking for traits linked to milk quality and production. About a year ago, the leading artificial insemination organizations in the United States and Canada funded a \$15-million research project directed by Curtis Van Tassell, a geneticist at the USDA's Bioregional Genetics Laboratory in Beltsville, Maryland. Working with Ilumina Inc. of San Diego, California, Van Tassell's team created a microarray chip containing 54,000 genetic markers called single nucleotide polymorphisms, or SNPs, that involve at least a dozen traits, including those known to affect milk quality and production.

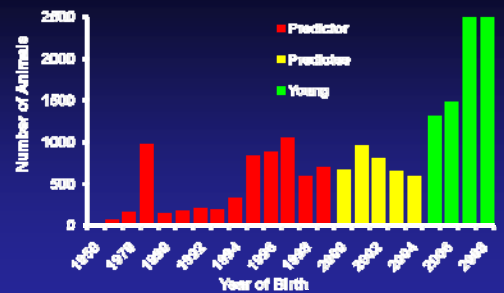
Using high-throughput analysis, the researchers could then compare the DNA from a young dairy bull against the chip SNPs, telling breeders which bull would be likely to sire calves that were good milk producers. The test costs about \$225, and can be done when a bull is born, thus avoiding the \$25,000-\$50,000 cost of raising a bull for five years to see if it sires good milk-producing offspring. "The best bulls become elite breeders," says Van Tassell. "The others become hamburger."

Previously, DNA tests allowed a typical breeder to select the best bull near 10% of the time, says geneticist Ole Madsen, vice president of Accelerated Genetics in Darabon, Wisconsin. The new technique identifies the best bull 70% of the time.

The US initiative is the first such nationwide programme. Companies in New Zealand and the Netherlands have set up private services for cattle breeders, and following the US model, similar systems are being built by researchers at Aarhus University in Denmark, and at Pioneer and Australia.

**Ben Dalton**

# J hqrp w|shg#Dq p d@#q@ 55/677-,



\*In North America as of February 2009

# H {shup hqwdc# hvlj q#X sgdwh

Krowhlg/#huhj/#hgg#Eurz q#z lv#uhhg

	HOL	JER	BSW
<b>Predictor:</b>			
Bulls born <2000	4,422	1,149	225
Cows with data	947	212	
<b>Total</b>	<b>5,369</b>	<b>1,361</b>	<b>225</b>
<b>Predicted:</b>			
Bulls born >2000	2,035	388	118

Data from 2004 used to predict independent data from 2009

# Uhdde lw| #J dlq<sup>4</sup> e | #Euhhg

\Inq#mullw#dqg#Q P ' #i:#rxqj #e#xow




Trait	HO	JE	BS
Net merit	24	8	3
Milk	26	6	0
Fat	32	11	5
Protein	24	2	1
Fat %	50	36	10
Protein %	38	29	5

'Gain above parent average reliability ~35%

Ydoxh#r i#J hqrw|s lqj #P ruh#D qlp dav  
 D fwxdd#iqg s ubg lfwng #j dlgrv#ru#b : #udlw#iqg #iru#Q hw#P hulw

Bulls		Reliability Gain	
Predictor	Predicted	NM\$	27 trait avg
2130	261	13	17
<b>Cows:</b>	<b>1759</b>	<b>23</b>	<b>23</b>
947	4422	24	29
1916	6184	31	30

Ghilqlqj #k h#J hqrp h#Fkdqj hv

Jurxs	Dqlp do	Qxp ehu	Elwk#hdu
4	Exæw	; 3	4<8504<: 8
5	Exæw	988	4<:904<; <
6	Exæw	66;5	4<<304<<<
7	Exæw	64<<	533305339
8	Exæw	484<	533:0533;
9	XP QbF	464	
:	XP QbV	47;	
;	FRZ V45;<		

Vlj qdwx:uhv#r i#v hchfwlrq#



73#|hdw#r i#dwlifldq#hchfwlrq#iru#k lj k #p ln#|Inog#  
 kdyh#fdxvhg#h{whqvlyh#} hqrp h#Fkdqj hv#  
 lqyrqylqj #d#æulj h#jxp ehu#r i#Fkurp rvrp hv  
 P r w#Q S#hlihfwng#e |#hchfwlrq#kdg#lj qlifdqw#  
 hihfw#r q#p s ruwdqwg dlu| #udlw  
 Vhchfwlrq#iru#p suryhg#p ln#surgxfwlrq#kdw#  
 unxæhg#q#kch#nguifk#p hqw#ru#hchdv#kdw#læw#  
 uhgx fh#ihwæw|



Qrz #Z kdwb\$

Z khuh#fdq#z h#j r#pjh{wB



Orz #G hqv|w| #D vvd |



Z kdwb  
 <9/#6; 7/#9; #7 1  
 Z k|B  
 Sduhqwdjh  
 43#w#63 ( #qfruhfw#s duhqwdj h  
 Wudfhde læw|  
 Idup #w# #run  
 J hqhwl#f#suhg lfwlrq  
 Iqwhup hg lwh#d#ffxudf|  
 Vkrwfxw#w#r #shg lj uh#h#gdwd



Orz #G hqv|w| #D vvd |

Z kdwb#w#rz G hqv|w|B  
 Wrgd| #k9/#6; 7  
 Vrrq=#4/33305/333  
 405#|hdw#63N  
 Ghqv|w| #z læghshgg#r q#Frvw  
 Whfkqrarj | #b#Fkdqj lqj #t x lfnc|



## Orz #G hqv| #D vvd |

Sduhgwdjh#dgg#G 2udfhde ldlw|  
 <9#p dunhuw#hdfwng#lurp #ErylqhVQ S83  
 Vndfwhg#lurp #VQ S#ghvfulhng#e |#Khdwrq  
 Ghvlj qhg#r#e#h#p rgx@u#J lqfrus rudwng#gwr#  
 rwhu#hvd|v  
 Krsh#r#fudwh#gh#dfwr wdqgdug#sdqho  
 Frrug lqdwng#z lkw#VDJ #dgg#Hxurshdq#  
 uhvdufk#j urxsv

## Orz #G hqv| #D vvd |

Vndfwh#; ; #dgg lwrq dcp dunhuw#r#suhg lfw#Q hw#  
 P hulw#g#K rowh lqv  
 Dffxudf | #qwhup hg ldlw#e h wz hng#s duhgw#lyhudj h#  
 dgg#83N  
 Frw#hiihfwh#ru#frp p hufldqgdul|#erz v#J  
 wdujhw#lv# ' 43  
 Ivvxhv#  
 P d{lp xp #suhg lfwlyh#erz hu  
 P xowls ch#VQ S#lq#OG ,#dvrfdwng#z lkw#h#h#j lrg

## Orz #G hqv| #D vvd |



Hqkdqfh#u#hsdfh#shg lj uh  
 Orz Cexgjhw#j hqrp h#hdfwlrq  
 Dffrxgw#ru#P hqghddq vdp sdqj#lurp #  
 sduhgw  
 Hqdeh#r#u#p suryh#j hqhwlf#suhg lfwlrq#z khuh#  
 shg lj uh#h#kqnrz q2qfruhfw  
 Ghyhars lqj#z ruw#J dwhv#rxcgdwlrq  
 H{whqvlyh#p dqdj hp hqwf#rqq lwrqv  
 Vrp h#gdul|#khugvBB



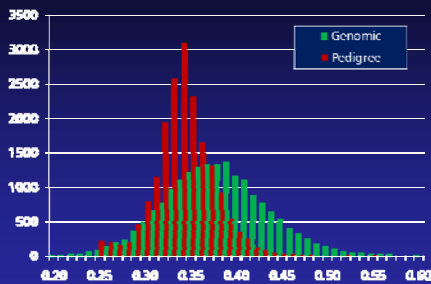
## J hqrw| sh#Shg lj uh

Frqxw#xp eh#i#h#e lwdul|#ahch



0 = homozygous for first allele  
 1 = heterozygous  
 2 = homozygous for second allele

## Exa# P JV#Thodwlrqvklsv



## K lj kh#G hqv| #D vvd |



Z kdwb  
 833N#r#P  
 Z k|B  
 Dfurv#euhg#j hqrp h#hdfwlrq  
 Dw#k lj kh#G hqv| /#lqndj h#j lmt x ldeulxp #  
 p d| #e#x iilflngw#ru#kduqj #kdsarw|shv  
 dfurv#euhgv  
 Surylgh#e hwhu#qirup dwlrq#ru#dgg lflqh fdwdh  
 Surylgh#e hwhu#z lkw lq#e uhng#suhg lfwlrq#e i#  
 j hqhwlf#p hulwB

# K l j k h u # G h q v l w | # D v v d |



G h v l j g # l w x h v

D a r i # E r y l q h V Q S 8 3 # f r q w h q w

W d x u l q h y v l q g l f l j h l q i r u p d w l r q # f r q w h q w

S u l r u l w | # e | # e u h g B

V s d f l q j

X q l i r u p

Y d u l d e d h # j p r u h # V Q S # q # h u d v # p s d f w # r q #

l p s r w d q w # s h u i r u p d q f h # u d l w

P l q r u # d o d h # u n t x h q f |

Z d q w # r p h # u d h # V Q S B

# E d f n # w r # K d s a r w | s h v

X q r u g h u n g # s d l v # i u r p # j h q r w | s h # g d w d

1 1 1 2 1 1 1 2 0 2 0 0

a g a t a g a c a g a c

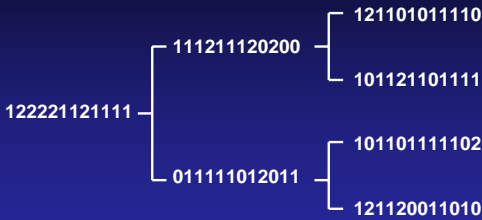
C t g t c t g c a g a c

D v v l j g # d f k # d o d h # w r # B # f k u r p r v r p h

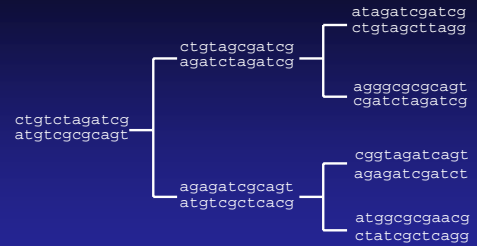
a g g t a t a c a g a c

c t a t c g g c a g a c

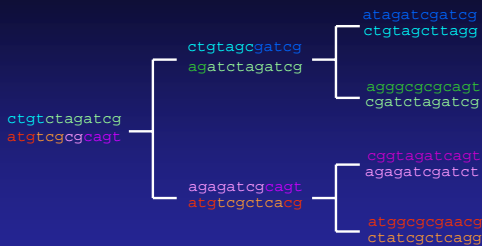
# J h q r w | s h # S h g l j u h



# V Q S # S h g l j u h



# K d s a r w | s h # S h g l j u h



# K d s a r w | s h v

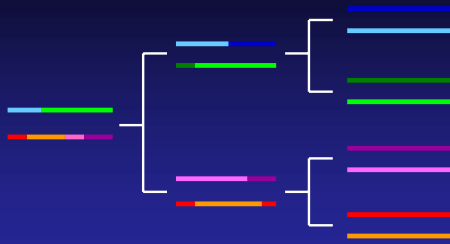
D a r z v # l q f u n d v n g # l f f x u d f | # r i # j h q h w l f #  
s u h g l f w i r q

122201101111

ctgtctagatcg

atgtcgcgcgcagt

## J hqrp lf#shglj uhh



## Surednp \$

Ghwhup lq lqj #kdsaw|shv#lv#frp sxwvwrqdw #  
g lllfxw  
lqfudhv#h{srgqhwdw|#q#lq lq d#qxp ehu#lqg#  
a fvx#qxp ehu  
Z lk#k lq khug hqvlw|#/Q S#g dwd#k lv#urednp #z l#  
eh#surednp dwlf  
Q hhg#p suryhg#lvwhp edhv#iru#fruhfw#p dunhu#  
rughu  
Q hhg#lqg lwrqdw#ht xhqflqj #r q#s r s xaw#lvh

## G Q D #vht xhqflqj #g dwd

Z l#h#e h#hdvle d#r #vht xhqf h#D l#e xaw#lq #1 06 #  
|hdwB  
Hfn#w#d#wht xhqfng # [ #ryhuj h#e i#d#fnylnk #  
exa#j 5 177 #p l#r q#/#Q S  
Ohz lq #w#d#wht xhqfng #d#k rowh lq #vln#45 [ ,# #  
vrq#9 [ ,#0 lghqwlilng#A 933/333#/#Q S  
XVGD #D UV#j hghudwhg#5 3 [ #r i#p rvw#s r s xaw#  
K rowh lq #vln#0 E adfnwdu  
XQ HVS X VGD #z runlqj #q #j hex#j hqrp h#  
Surrhfw#z lk#j rd#d#ruvgh#ryr#lvwhp ed#  
xvlqj #787# #j D5 {#gdwd

## G Q D #vht xhqf h#g dwd



Kdsaw|s lqj #p ruh#s udfwldq#z lk#vht xhqf h#  
gdwdB  
Uduh#/#Q S#k h#e #ghqvlw| #s k dvh  
X aw#p dwh#jgdwd#lvh#vht xhqf h#ghulyhg#urp #vlqj d#  
p r d f x d #vht xhqf lqj #  
Vht xhqf h#d f k #w d q g #z i #G Q D #lq g l y g x d w #  
d q g #f r p s d w h q  
R q #k h #k r u l #r q #j h l j 1 #D F #E l r v f l h q f h v #  
R { i r u g #Q d q r s r u h

## Vxp p du|



VQ S#j hqrp|s lqj #lv#udqvirup lqj #k h#g d l | #  
lq g x w w l |  
E h h i #z l #r a r z y p d | e h y g l i h u h q w o y  
R w k h u #v s h f l h v #r #i r a r z B  
O r z h u #g h q v l w | #d q h o B  
K l j k h u #g h q v l w | #k r x w #h v x o #l q #e h w h u #v r p h B , #  
d e l w | #r #k v h #j d w d #i f u r v w #e u h g v  
V h t x h q f l q j #z i #p s r w d q w d l q p d a #v #k h #  
x a w #p d w h #g g s r l q w

## Ixqg lqj



XVGD Q U I Z F V U H H V  
5339058949099<<  
533905853809;;;  
533905853809;34  
XVGD D U V  
45980643330;40  
45980643330<30  
876; 0643330; 60  
P h u k o  
V h z d i a e #d o f n  
Q D D E  
J r u g r q #r d n  
D E V I T a e d o  
D f f d i d u s h g #f h q b e l v  
D w d H H h q b e l v  
F U Z I h e p l  
V h s h f w l i v  
V h p h #l o d i g f h  
W d k a v #l r u g #h



# Whdp v́y



## P lvwxul

Muu|#d|aru  
Ere#kqdeho  
Vhskdqh# #nd|

## XVP DUF

Wp #p lk  
P dndmq

## Dæhuad

Vhyh# rrih

## læxp lqđ

P d|dq# xqvq  
Fqj|#dz d|  
Fkubdq#dxghqvdkg  
Ghe#dih|

P hñ#kxp svzq  
Mhñ# dñmæd

## DISO

Sdxq#dqđqghq  
P hñ#rrih  
Jhriy#h# ljdqy  
Mhñ#Frgqho  
Mkq#Frdh  
Gdq#xæ  
Mqđ#qz dgy

## EIJO

Fxum#dq#đvwhæ  
Vhyh#Fkuchghu  
Ddfñ#Ehdyhu  
Odnwep lP dwnxp dæl

Xqlyhu#l# #h# lfrqvly  
Nhq#h# hñho) #wqghqw