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MAKING A DIFFERENCE IN MINNESOTA: ENVIRONMENT + FOOD & AGRICULTURE + COMMUNITIES + FAMILIES + YOUTH

Feeding and Management Practices for Robotic Milking Success

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Driven to Discover℠

Hitting targets for efficiency is important to maximize profit.

Box robots

140-190 attaches/24 hrs

2.4-3.0 milkings/cow/day

< 5 failed milking/robot/day

5-10 fetch cows/robot/day

Goals for milk per robot

- 4000-4500 lbs – OK
- 4500-5000 – Good
- >5000 - Excellent

Best farms

170 – 190 attaches/24 hours

<3 failures

>6000 lbs milk/robot

Device Name	Milk Yield last 24hrs	Avg Yield Per Day Last 7 days
VMS 1	6778.9	6399.7
VMS 2	6148.9	5915.7
VMS 3	6492.4	6131.8
VMS 4	6871.5	6319.4

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Single Box
Systems
DeLaval
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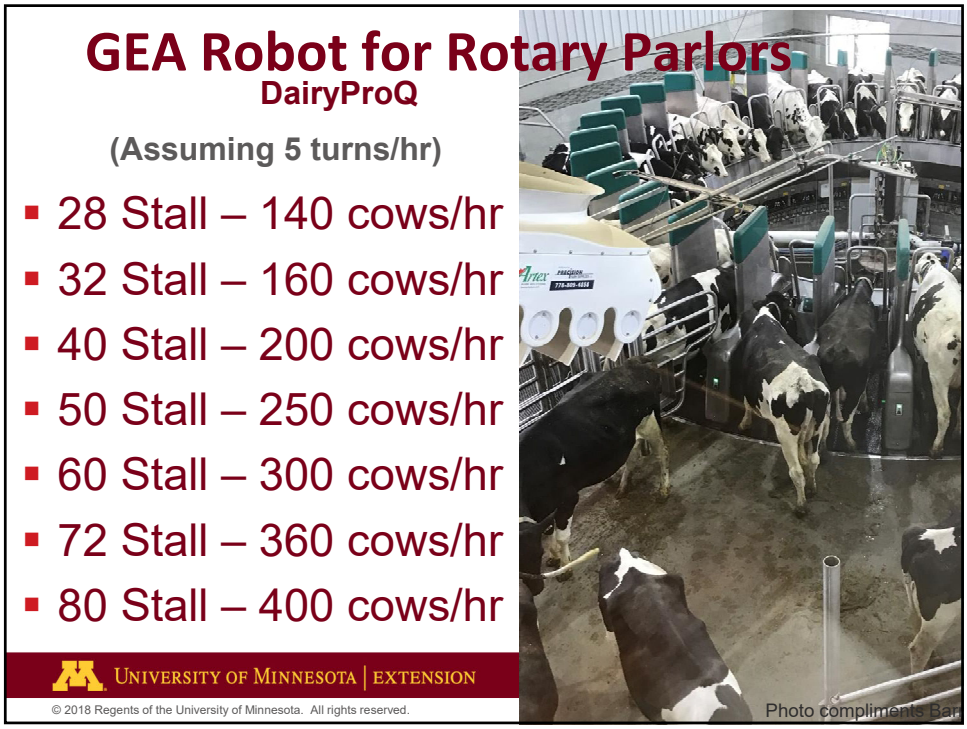
GEA Robot for Rotary Parlors
DairyProQ
(Assuming 5 turns/hr)
28 Stall – 140 cows/hr
32 Stall – 160 cows/hr
40 Stall – 200 cows/hr
50 Stall – 250 cows/hr
60 Stall – 300 cows/hr
72 Stall – 360 cows/hr
80 Stall – 400 cows/hr
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Photo compliments Bar

DeLaval Rotary Parlor

- 90 cow/hour
- Two prep arms
- 2 attach arms
- One post dip arm

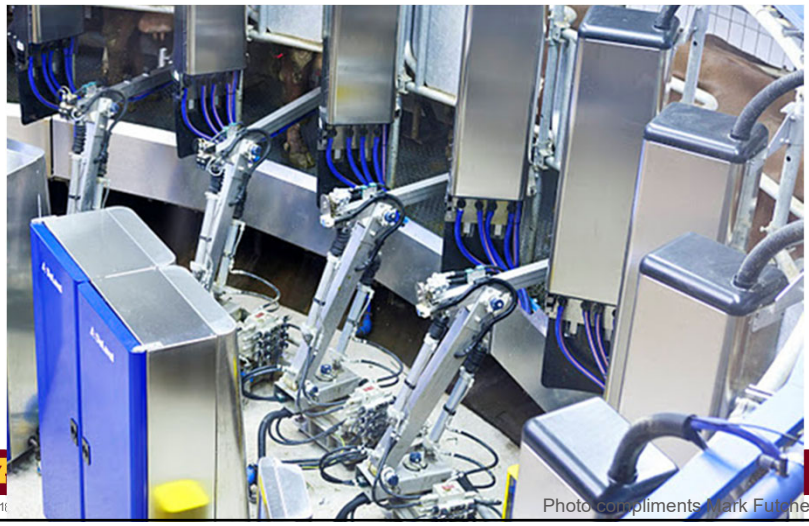


Photo compliments Mark Futcher

Batch vs Voluntary Milking

Batch

- Similar mgt to conventional milking
- Control over milking frequency
- Labor in barn 24/7/365 If milking 24/d
- Pens are empty for activities
- No change in feeding

Voluntary

- Deal with imperfections of cow behavior
- Lose some control of milking frequency
- Flexible milking frequency
- Flexible labor
- Feed changes have impact on visits
- Fetch cows in each pen

Keys to success - barn design

Need to accommodate movement of:

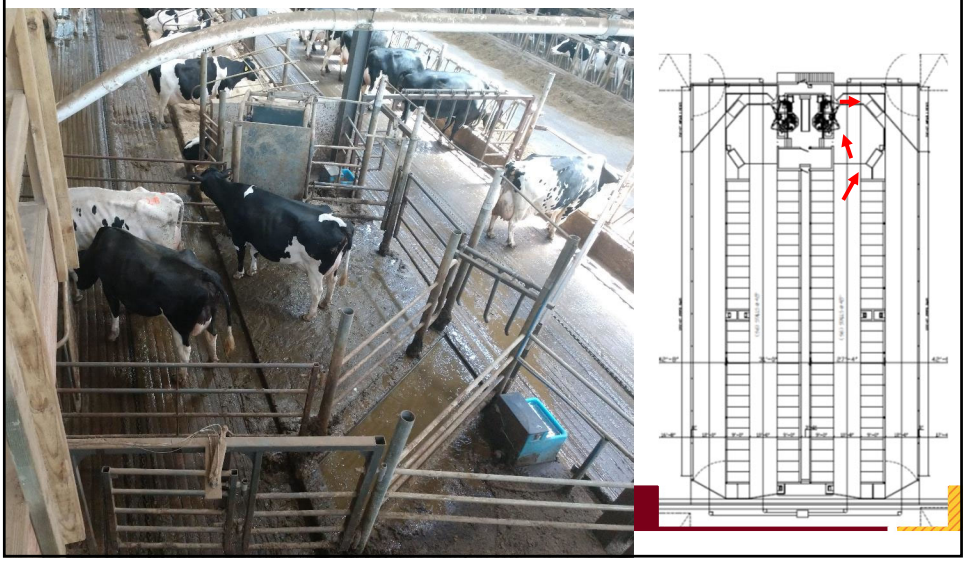
- Feed
- Manure
- Cows
  - Comfort
  - Easy access to robot
- People

Challenge:

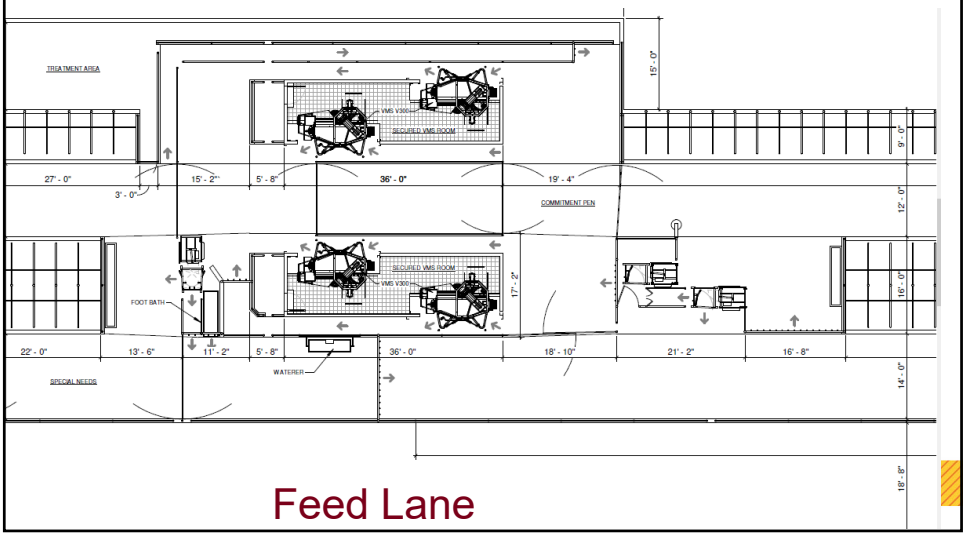
- Minimize labor
- Work around cows in pens for bedding and/or manure removal
- Design to encourage natural cow movement to milk box area
- System to handle cows that need management interventions

Free flow system

Milk first guided flow – exit directly into the feed lane



Modified Guided flow – access to beds from feed lane



Feed Lane

Keys to success with robots

Excellent feed management

Survey results

- Feed management ranked 1st
- Pellet palatability and quality ranked 2nd

Nutritionist that likes the challenge of robots

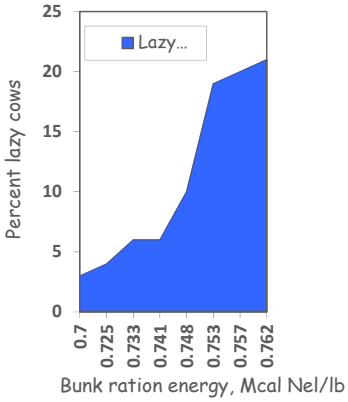
For success of robots we need to entice cows to visit the milking station or box

Balance between PMR in the bunk and concentrate pellet in the RMS box

Feeding to meet your goals

Balancing energy in AMS vs. bunk

- high forage/low energy TMR drives cows to robot – may limit milk production
- high energy TMR – increase late lactation "lazy" cows



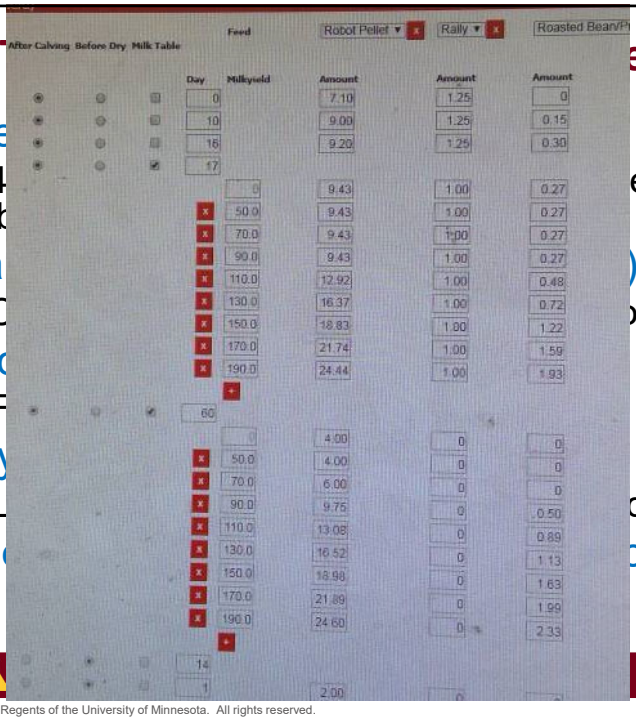
Rodenburg, 2008

How much concentrate to feed through AMS

- increase risk of acidosis and lameness
- off feed problems

Free flow vs Guided flow feeding strategies

"-



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"Typical" Guided Flow feeding strategies

Feeding more robot pellets increased visits for cows voluntarily milked, but did not decrease fetch cows.

	6.6 lb AMS pellet	17.6 lb AMS pellet	P-value
Total milkings/d	2.6	2.8	.13
Not fetch cows	2.4	2.7	<.05

Bach et al, JDS. 2007

Low and high forage PMR with low (4.4 lbs) and high (13.2 lbs) AMS pellets.

Ing	L-For (54:46 F:C)		H-For (64:36 F:C)	
	H-AMS	L-AMS	H-AMS	L-AMS
aNDFom	27.7	29.5	29.4	31.6
ADF	17.6	19.3	19.3	21.4
Starch	33.9	30.2	30.4	26.2
NFC	44.2	41.3	41.7	38.4

[1]The pellet provided in the AMS was the same pellet used in the PMR. Other analysis for treatments were similar: DM of PMR=50%, CP=16.5%, EE=3.75%

H-AMS targeted 13.2 lbs. of robot pellets and L-AMS targeted 4.4 lbs. of AMS pellets daily

Menajovsky et al, 2018

High AMS cows tended to have a lower milk fat percent and had a higher milk crude protein percent compared to low AMS fed cows.

	L-AMS (4.4 lbs)	H-AMS (13.2 lbs)	*P*-value
Milk, lbs/c/d	83.8	86.4	0.10
Milk Fat, %	3.63	3.51	0.09
Fat, lbs/d	3.02	3.00	0.76
CP, %	**3.20**	**3.25**	**0.04**
CP, lbs/d	2.67	2.80	0.07

Menajovsky et al, 2018

Robot pellet intake variability increases with increasing pellet allocation

	L-AMS[1] (4.4 lbs)	H-AMS[1] (13.2 lbs)	*P*-value
Min AMS, lbs/d	3.65	10.71	<0.01
MAX AMS, lbs/d	5.25	16.25	<0.01
Daily SD, lbs/d	0.55	1.87	<0.01

[1]To achieve targeted AMS pellet intake cows,were eligible for 4.56 and 14.44 lbs. of AMS feed daily for the L-AMS and H-AMS treatments respectively

Menajovsky et al, 2018

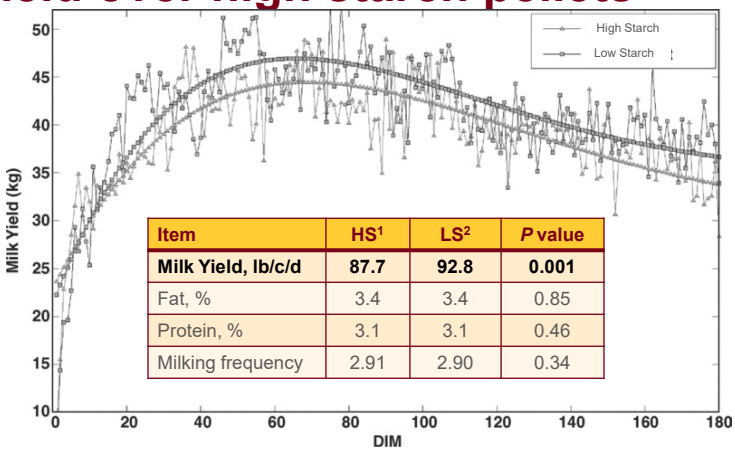
Soyhull based pellets had higher milk fat percent but lower protein percent than barley based pellets.

Item	SH	BG	*P* value
Auto concentrate visits	8.60	9.12	0.14
Pellet intake, kg/c/d	19.0	19.0	0.85
Milk yield, kg/d	87.1	89.8	0.37
Milk fat, %	**3.37**	**3.09**	**0.05**
Milk protein, %	**2.92**	**3.06**	**0.01**

BG = 18% barley, 12% corn, 0 % soyhulls, 24.2% NDF
SH = 0% barley, 11.2 corn, 18% soyhulls, 44.1% NDF

Miron et al., 2004 JDS 87:3808

Low starch pellets increased milk yield over high starch pellets



Item	HS[1]	LS[2]	*P* value
Milk Yield, lb/c/d	**87.7**	**92.8**	**0.001**
Fat, %	3.4	3.4	0.85
Protein, %	3.1	3.1	0.46
Milking frequency	2.91	2.90	0.34

[1] 34.4% corn, 0 % soyhulls: 22.1% NDF, 47.9% Starch + Solu
[2] 18.8% corn, 30% soyhulls: 28.5% NDF, 40.9% Starch + Solu

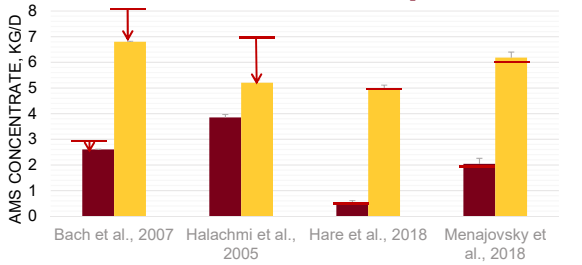
Halachmi et al, 2009 JDS 92

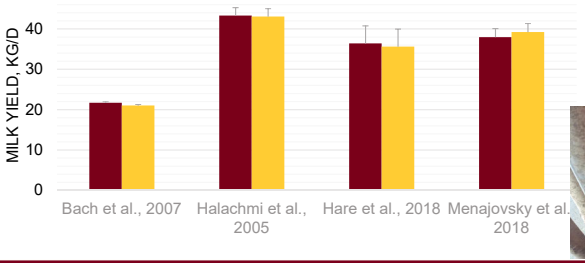
Feeding more robot pellets has mixed substitution effect on PMR intake.

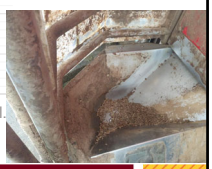
Study	Ration	Substitution
Bach et al, 2007 191 DIM, 71.5 lbs, Mixed parity	Isocaloric	1.14
Hare et al, 2018 188 DIM 79.4 lbs, Mixed parity	Isocaloric	1.58
Menajovsky et al, 2018 141 DIM, 83.6 lbs, Multiparous	Hi-F PMR	0.78
Menajovsky et al, 2018 141 DIM, 86.6 lbs, Multiparous	L-F PMR	0.89
Paddick et al, 2018 90 DIM, 82.5 lbs, primiparous	Isocaloric	0.97

Adapted from Paddick et al, 2018

At high feeding levels cows may not consume all robot feed and have lower milk production.



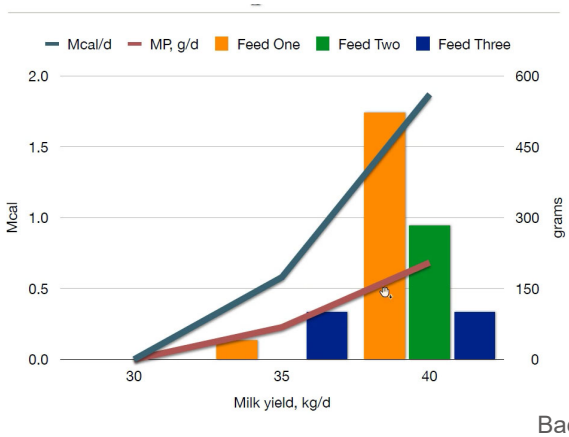




K. Paddick, 2018

At high feeding levels cows may not consume all robot feed

Feeding multiple feed types will meet nutrient needs more precisely.



Bach, 2014

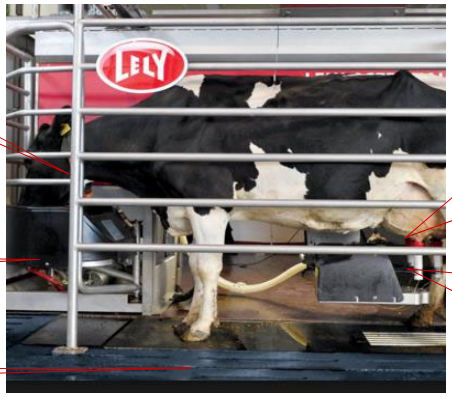
Fresh cow management

- Special observation of fresh cows
- Observe rumination, activity and manure daily
- Palatability of PMR as well as pellets is important
- Frequent fetching of fresh cows
- Multiple feeds through robot box allows flexibility

Feeding COWsistency

- Consistent PMR dry matter
- Consistent mixing and delivery
- Consistent feed push ups
- Consistent and frequent fetching
- Highly palatable PMR
- Highly palatable, consistent, high quality milking box feed

Weekly long term analysis: > 120 Values/cow/day



From: Ben Smink

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Cows with lower rumination time before calving maintained that lower rumination time after calving and had a higher incidence of clinical disease: (conventional milking system)

- Retained placenta
- Mastitis
- Ketosis
- Metritis
- DA
- Lameness

Soriani et al., 2012

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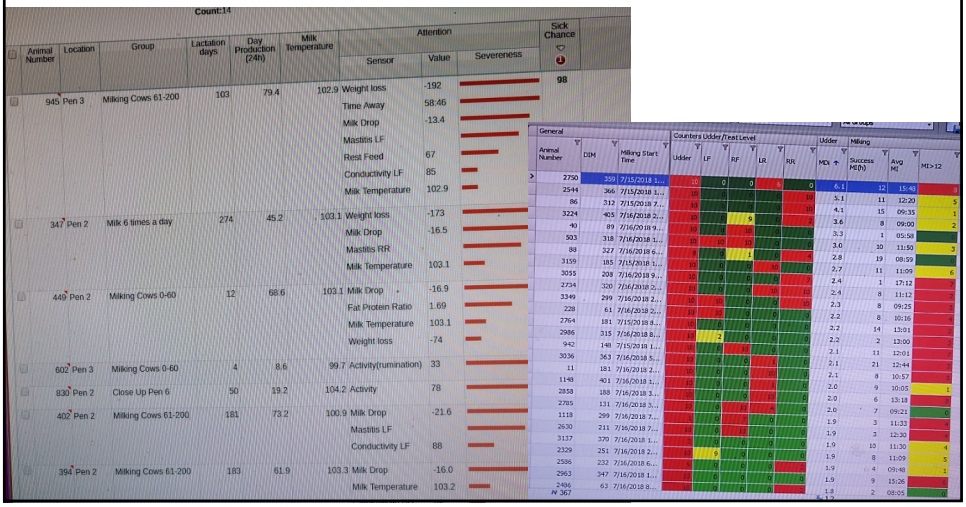
Research on robotic dairies

Activity reductions began 4 to 7 days before diagnoses of DA, pneumonia, subclinical ketosis, and metritis by 20 to 40% total.

Body weight reductions began 4 to 6 days before pneumonia, ketosis, hoof disorders, and metritis diagnoses (22 to 31 lbs per day).

King et al., 2017

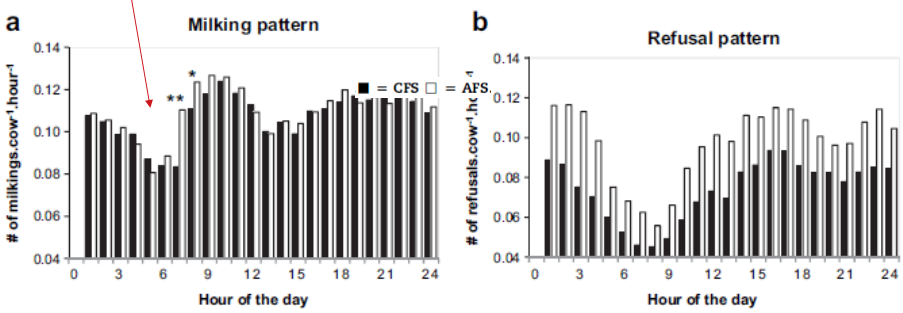
Producers find health reports valuable



Milking patterns varied between conventional and auto fed herds.

Conventional am feeding affected visits

+20.8% for AFS - not statistically different



Belle, et al, Biosystems Engineering, 2012

Keys to success with robots

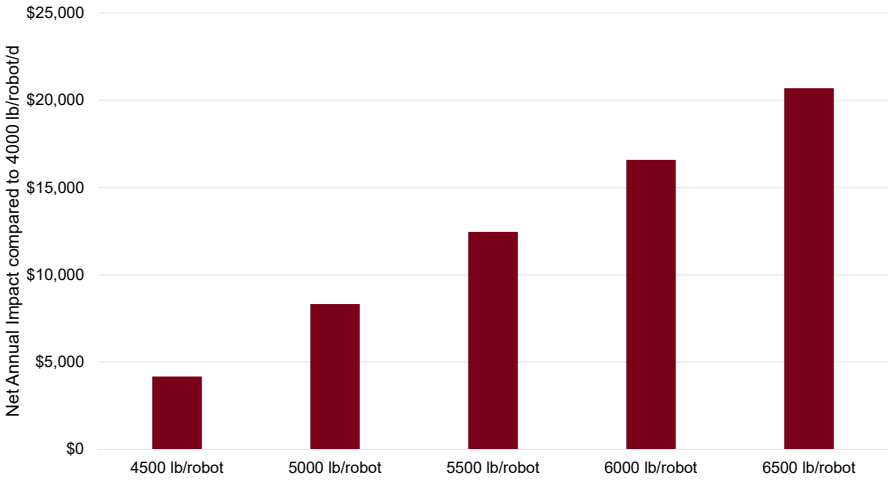
High milk production per robot

Milk production change when switching to robots is widely variable

Factor include

- Robot effect – cows not leaving pens, 24 access to feed, water, beds
- Milking frequency effect
- Barn effect – changes to facility

Net Annual impact by milk yield per robot[1]



[1]Net annual impact per robot compared to 4000 lb/robot/d

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High milk per robot is possible

Device Name	Milk Yield last 24hrs	Avg Yield Per Day Last 7 days	Milk Yield To Tank Last 24hrs	Avg Yield To Tank Per Day Last 7 days	Avg. Yield / Milking Last 24h	Milkings Last 24hrs	Divert Milking Last 2
VMS 1	6778.9	6399.7	6778.9	6388.2	39.9	170	
VMS 2	6148.9	5915.7	6148.9	5830.9	41.3	149	
VMS 3	6492.4	6131.8	6492.4	6131.8	40.1	162	
VMS 4	6871.5	6319.4	6871.5	6255.0	40.4	170	

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Visits per day, milking speed, cows per robot and robot feed, residual feed and failed visits are associated with more milk per robot.

Variable	Effect[1]
Milking visits per day	+++
Milking speed, lb/min	+++
Cows per RMS unit	+++
Robot feed, lbs/cow	++
Residual feed, lbs/cow/d	---
Failed visits, failed visits/c/day	--
Refused visits	--

[1] $P<0.0001$

Siewert et al, 2017

Milk per cow

Milkings per day, milking speed, robot feed, residual feed and failed milkings are associated with more daily milk cow.

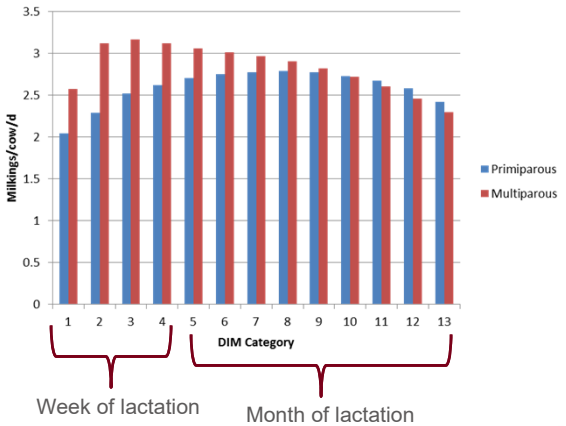
Variable	Estimate
Milking visits per day	+++
Milking speed	+++
Robot feed	++
Residual feed	---
Failed visits	--
Refused visits	--

[1]*P*<0.0001

Siewert et al, 2017

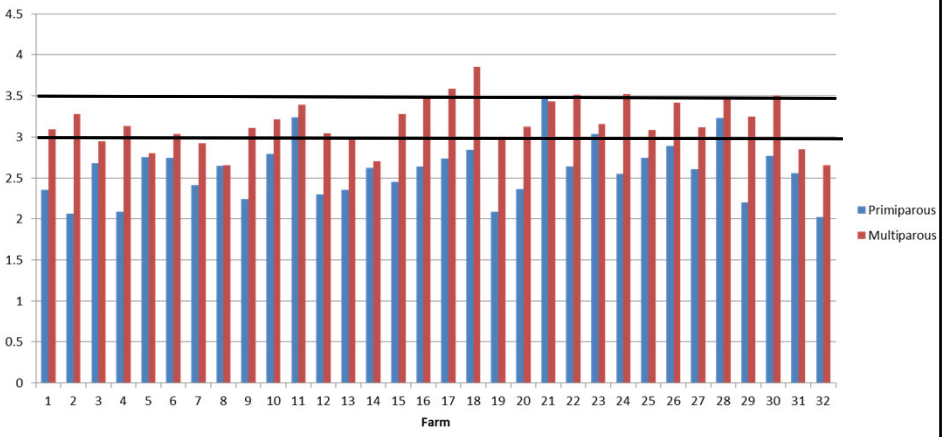
First lactation cows get off to a slow start compared to older cows

But – once adjusted first lactation cows' milking frequency exceeds older cows



Siewert, et al, 2017

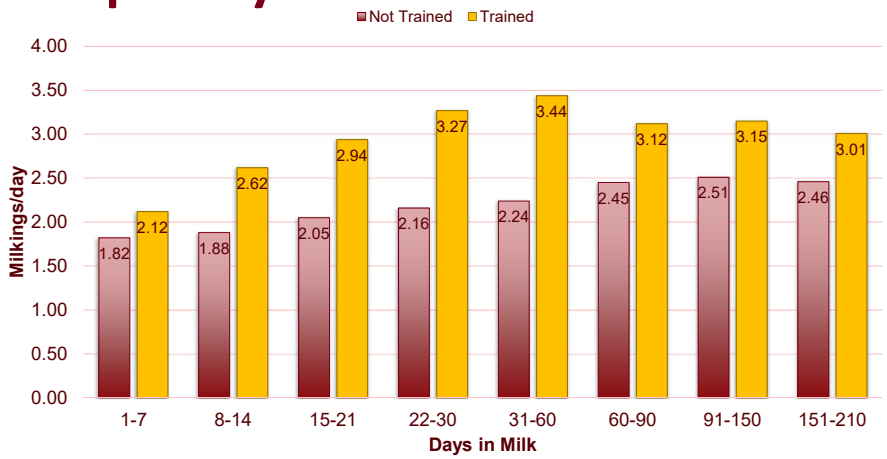
Fourth week milking frequency was lower than desired for many herds



Siewert et al, 2017

Pre-training heifers decreases fetching after calving

Pre-trained heifers visited more frequently



Peiter et al, 2018

Some farms are installing training stalls

Herds with automatic feed push up had more milk per robot and milk per cow.

Item	Milk per robot	Milk per cow
Automatic feed push up	4580[a]	
Manual feed push up	3804[b]	
Contained bunk	4177[a,b]	

Almost 11 lbs more milk per cow with automatic feed push up!

[a,b] Means within variables differ ($P < 0.05$)

N=33 free flow cow traffic herds

Siewert et al, 2018

Sire selection

Sires selection for daughters with short box time
Heritability of voluntary milking is 0.16-0.22 (de Konig, 2006)

Production index					
%Rel	Dtrs	Hrd	Base	Src	
79	36	11	Z	NLD	
Kg milk	% fat	% prot	Kg fat	Kg prot	Inet
-26	0.16	0.08	9	4	34

Functional traits		
Sire		%Rel
Calving ease	103	74
Vitality	101	39
Beef index	94	68

Daughters		
Fertility	102	59
NR	104	34
Calving interval	101	67
Mat. Calving process	0	0
Mat. Vitality	99	41
Persistency	102	65
Maturity rate	97	49
Udder Health	102	55
Somatic cell count	99	72
Milking speed	0	0
Robot efficiency	99	60
Robot interval	108	52

92 94 96 98 100 102 104 106 108

Reduced box time per cow

- Select for cows that milk and attach fast
- Keep RMS equipment in top working condition
- Singe udders
- Trim tail switches

Keys to increasing milk per robot

- High milk production per cow
  - Fetch early lactation cows often
  - Well balanced diets and excellent transition cow program
  - High reproductive efficiency
  - Excellent cow comfort
  - Low somatic cell count
- Minimize box time per cow
  - Cows that attached fast
  - Cows that milk fast
  - Carefully thought out milking permission settings
- Minimize free time
  - May increase the number of fetch cows in free flow systems
- Select robot herd

Summary

Factors for success

- Well balanced, palatable PMR along with a palatable pellets
- Carefully thought out milking permissions and feeding tables
- Focus on maintaining fresh cow health.
- Concentrate on early lactation visits for heifers
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