Economics of Using Beef Semen

Wen Li and Victor E. Cabrera
Department of Dairy Science
University of Wisconsin-Madison
WI, 53706
Email: vcabrera@wisc.edu

Introduction

Beef semen on dairy has gained notoriety because of the attractive market value of crossbred beef calves and the availability of enough dairy replacements due to improved reproduction performance. The profitability of the beef semen utilization is principally influenced by: 1) dairy and beef market calves price; 2) reproductive performance; and 3) semen combination strategies (Mur-Novales and Cabrera, 2017). Considering the complicated interaction among these factors, the Premium Beef on Dairy tool from the University of Wisconsin-Madison DairyMGT.info (Lopes and Cabrera, 2014) has been developed to address questions related to the utilization of beef semen on dairy cattle. This study updated and adjusted the Premium Beef on Dairy model and tool with the objective of comprehensively analyze the economics of using beef semen under different reproductive performance and current market conditions.

Materials and Methods

The Farm Model. Based on a herd simulation involving Markov chains (Cabrera, 2012), a farm with 1,000 Holstein cows was simulated on a monthly basis. In the model, each cow was designed as in different state of lactation (Lact), month in milk (MIM), and month pregnant (Preg) and each heifer as in different state of age in months (AIM) and month pregnant (Preg). The HEIFER model was an addition to the original Premium Beef on Dairy model. A variety of converting events, such as non-reproductive culling, reproductive culling, mortality, milking status, and pregnancy, were taken into consideration in each iteration. After a voluntary waiting period (60 days for cows and 420 days for heifers), reproductive events were summarized in 30-day periods. With 7% discount of mortality and stillbirth, the female calves generated from the COW model were input into the HEIFER model, leading to the two models running together until reaching steady state considering that the adult herd size remained constant in size (Cabrera, 2012) and determining the produced calves and springers. Female calves and springers balances were calculated as the difference between the produced and required. Required calves and springers were a function of the selected semen utilization protocols. Monthly numbers of cows and heifers eligible to be bred, based on the population demographics drawn from the farm model, were used to study alternative semen utilization (Table 1). We evaluated 3 different reproductive levels (High, Medium, and Low) under a turnover rate at 35% to represent plausible farm situations. High reproduction farms require less replacements (Table 1).

Table 1. Reproductive performance, resulting eligible animals to breed, and female calves and springers required to maintain the 1,000-cow herd size constant calculated with Markov-chain model at steady state assuming a turnover rate of 35%/year.

		Reproduction Level		
		High	Medium	Low
Heifers, Conception rate1st service (%)		60	55	50
Cows, 21-day Pregnancy rate (%)		30	20	15
	Service	Breed eligible animals (head/month)		
Heifers	1st	43	36	31
	2nd	24	21	19
	3rd	15	14	14
	>3rd	29	31	34
Lactation 1	1st	22	27	31
	2nd	12	19	24
	3rd	7	13	19
	>3rd	16	35	55
Lactation 2	1st	17	19	19
	2nd	10	13	15
	3rd	6	9	11
	>3rd	12	23	32
Lactation >2	1st	29	24	19
	2nd	16	16	15
	3rd	9	11	11
	>3rd	27	39	43
		Required animals (head/month)		
Female calves		33	39	47
Springers		27	32	36

The Economic Model. Following Mur-Novales and Cabrera (2017), an economic model was adjusted to evaluate the income from calves over semen costs (ICOSC) when different combinations of conventional, sexed, and beef semen are used in a Holstein herd under different market, management, and technological conditions. It was assumed that in order to keep the adult cow herd size, female calves needed to be purchased from outside market if females born in the farm fall short to cover the replacement needs. Similarly, if females born in the farm were in excess, these would be sold for an income. Thus, the ICOSC was calculated as:

$$\text{ICOSC} = HF_{born} \times PHF + HFS_{born} \times PHFS - HF_{req} \times PHF + HM_{born} \times PHM + B_{born} \times PB - Cow_C \times PCS - Cow_S \times PSS - Cow_B \times PBS$$

Where HF_{born} = Holstein female from conventional semen calves born in the farm, HFS_{born} = Holstein females calves from sexed semen born in the farm, HF_{req} = Holstein females required to cover the replacement needs, HM_{born} = Holstein male calves born in the farm, B_{born}= Beef crossbreed calves born in the farm, Cow_C = cows and heifers inseminated with conventional semen, Cow_S = cows and heifers inseminated with sexed semen, Cow_B = cows inseminated with beef semen and PHF, $PHFS$, PHM, PB, PCS, PSS, PBS are the sale prices of a Holstein female calf, a Holstein female calf coming from sexed semen, a Holstein male calf, a beef cross breed calf, a dose of conventional semen, a dose of sex-sorted semen, and a dose of beef semen, respectively. The prices of a Holstein female calf coming from conventional and sexed semen were different when considering the genetic improvement of sexed semen. However, it was assumed that $PHFS$ was equal to PHF in cases where female calves needed to be bought to stabilize the herd size. All values, except market prices, were determined using the Premium Beef on Dairy tool from the University of Wisconsin- Madison Dairy Management website (DairyMGT.info: Tools; Lopes and Cabrera, 2014).

Variables. Breed eligible animals from Table 1 were used to evaluate semen scenarios with respect to ICOSC and female calf balance (FCB). The 21-d service rate was fixed at 75% for heifers and 60% for cows under all reproductive levels. Fertility of sex-sorted semen to conventional semen was set to 80% (Seidel, 2014) and conception rate of beef semen was set be the same as conventional semen conception rate (Mur-Novales and Cabrera, 2017; Table 2). Percentages of female calves from conventional and sex-sorted semen were set at 47% and 90%, respectively.

Table 2. Conception rates (%) of 3 types of semen for animals at different services.

		Reproduction Levels								
		High			Medium			Low		
	Service	Conv.[1]	Sexed[2]	Beef[3]	Conv.	Sexed	Beef	Conv.	Sexed	Beef
Heifers	1st	60	48	60	55	44	55	50	40	50
	2nd	55	44	55	50	40	50	45	36	45
	3rd	50	40	50	45	36	45	40	32	40
	>3rd	40	32	40	40	32	40	30	24	30
Lactation 1	1st	45	36	45	40	32	40	35	28	35
	2nd	40	32	40	35	28	35	30	24	30
	3rd	35	28	35	30	24	30	25	20	25
	>3rd	25	20	25	20	16	20	20	16	20
Lactation 2	1st	40	32	40	35	28	35	30	24	30
	2nd	35	28	35	30	24	30	25	20	25
	3rd	30	24	30	25	20	25	20	16	20
	>3rd	20	16	20	15	12	15	15	12	15
Lactation >2	1st	35	28	35	30	24	30	25	20	25
	2nd	30	24	30	25	20	25	20	16	20
	3rd	25	20	25	20	16	20	15	12	15
	>3rd	15	12	15	15	12	15	10	8	10

[1]Conventional semen; [2]sex-sorted semen; [3]beef semen.

Five strategies of beef semen utilization were combined with 6 strategies of sexed semen utilization under variable prices. Consistent with farm management, beef semen utilization was restricted to adult cows not being inseminated with sex-sorted semen at percentages of 1) 0, 2) 25, 3) 50, 4) 75 and 5) 100 of eligible animals. The sexed semen scenarios included: 1) No sexed semen (NS); 2) 1st service in heifers (1H); 3) 1st and 2nd services in heifers (2H); 4) 1st and 2nd services in heifers and 20% cows with top-genetic at each service (TOP); 5) 1st and 2nd services in heifers and 1st service in primiparous cows (1C); and 6) 1st and 2nd services in heifers and 1st service in primiparous and second-parity cows (2C). Therefore, conventional semen was used on eligible animals neither bred to beef nor to sexed semen. There were 90 basic scenarios resulting from 5 beef semen scenarios, 6 sexed semen scenarios, and 3 farm reproductive levels.

Semen and calf prices that represent current Wisconsin condition (Table 3) were used for the baseline analyses.

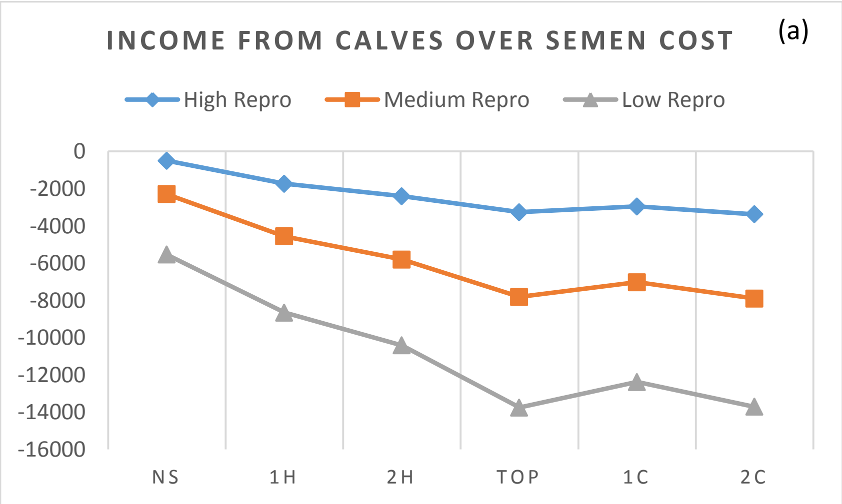
Table 3. Default semen and calf prices.

Variable	Value
Conventional semen price (CS, $/ dose)	15
Sexed-sorted semen price (SS, $/ dose)	35
Beef semen price (BS, $/ dose)	15
Wisconsin current market price[1]	
Price of Holstein female calf from conventional semen(PHF, $/ head)	45
Price of Holstein male calf (PHM, $/ head)	57.5
Price of Holstein female calf from sex-sorted semen (PHFS[2], $/ head)	45
Price of beef calf (PB, $/ head)	225
Pirce of Holstein female calf purchased for market (PHFP[3], $/ head)	45

[1]Wisconsin current market price: market prices were averaged according to Stratford Market Report (12/04/2018), www.equitycoop.com.
[2]PHFS: the default value of Holstein female calf from sex-sorted semen was assumed to be the same as the one from conventional semen.
[3]PHFP: The value of Holstein female calf produced and purchased were assumed to be the same.

Results and Discussion

Wisconsin Current Market Conditions. The baseline analysis (Figure 1) indicated that without using beef semen (0% beef semen), all sexed semen utilization scenarios resulted in negative ICOSC. This was expected because the relatively low price of Holstein calves compared with the relative high semen costs. Mur-Novales and Cabrera (2017) reported positive ICOSC when Holstein calf prices were much higher ($262 PHF and $100 PHM) and semen costs were the same. Consistent with higher reproductive performance, herds with better performance have always higher ICOSC (Figure 1a) and more positive female calves balance (Figure 1b).



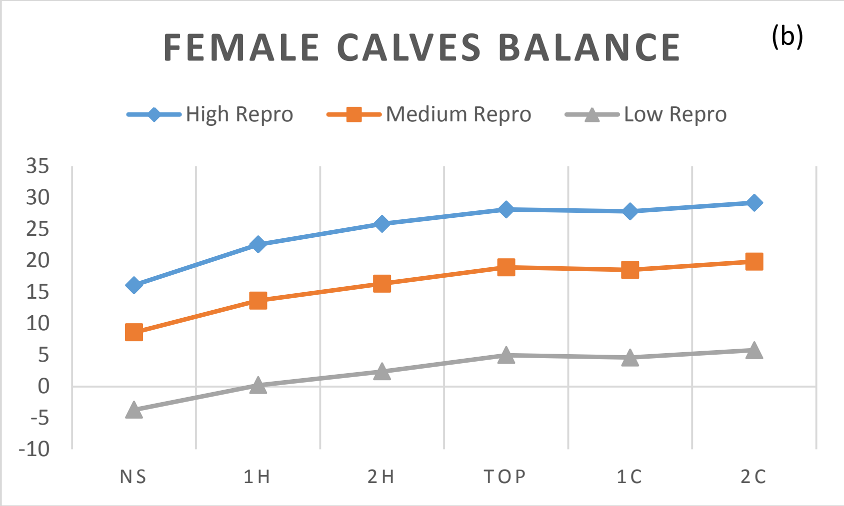
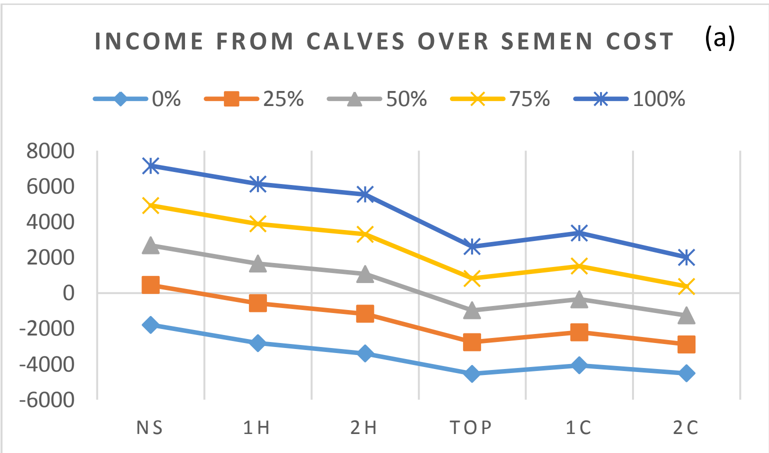


Figure 1. Income from calves over semen cost, ICOSC (a), and female calves balance, FCB (b), for 3 reproductive performance levels (Table 2) without any beef semen utilization (0% beef semen) under default Wisconsin market conditions (Table 3). Sexed semen utilization followed: no sexed semen (NS); 1st service in heifers (1H); 1st and 2nd services in heifers (2H); 1st and 2nd services in heifers and 20% cows with top-genetic at each service (TOP); 1st and 2nd services in heifers and 1st service in primiparous cows (1C); and 1st and 2nd services in heifers and 1st service in primiparous and second-parity cows (2C).

The ICOSC and FCB with different sexed semen and beef semen strategies for medium reproductive performance under current market conditions are presented in Figure 2. As seen, when sex-sorted semen utilization increased from NS to 2C, the ICOSC gradually declined. In all sexed semen strategies, maximum use of beef semen (100% beef semen) resulted in the highest ICOSC, but still, nearly half data points (13 out of 30) remained negative (Figure 2a). As expected, the female calves balance curves showed an opposite direction and the 100% beef semen strategy resulted in the lowest FCB (Figure 2b). Because sex-sorted semen is relatively expensive, increased utilization decreased the ICOSC. Also, due to relative high crossbreed beef calf price compared to low Holstein female calf price, more beef semen use increased the ICOSC while producing less female Holstein calves. In Mur-Novales and Cabrera (2017), more use of beef semen also resulted in higher ICOSC, but the difference was not as marked as here due to the relatively smaller margin between PHF of $262 vs. PB of $190 compared with the current situation of PHF of $57.5 vs. PB of $225.



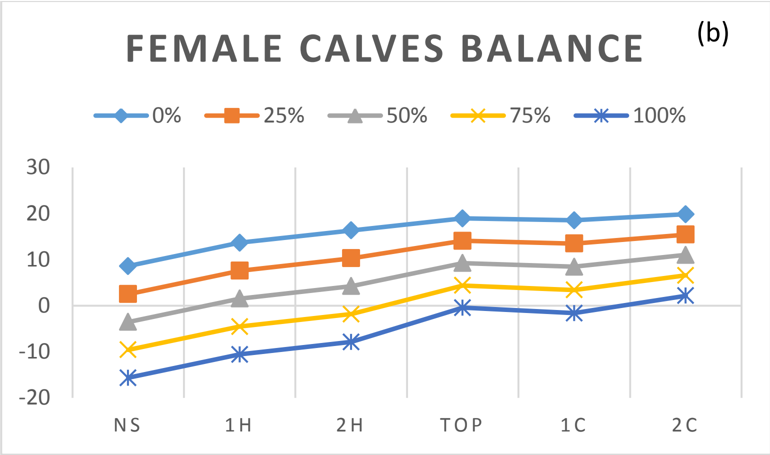


Figure 2. Income from calves over semen cost, ICOSC (a) and female calves balance FCB (b) for Medium reproductive level farm under current Wisconsin market conditions. Sexed semen utilization followed: no sexed semen (NS); 1st service in heifers (1H); 1st and 2nd services in heifers (2H); 1st and 2nd services in heifers and 20% cows with top-genetic at each service (TOP); 1st and 2nd services in heifers and 1st service in primiparous cows (1C); and 1st and 2nd services in heifers and 1st service in primiparous and second-parity cows (2C).

Highest ICOSC and Optimal ICOSC. Two criteria were defined to evaluate the best strategy, highest ICOSC and optimal ICOSC defined as the highest ICOSC with FCB >= 0. Most cases of highest ICOSC had negative FCB (Table 4), which indicates replacement deficiency. Considering this ubiquitous deficiency for highest ICOSC, the best strategy, restricted by the optimal ICOSC, could be a better indicator (Table 5). To illustrate this dilemma, we present Figure 3 simulating the current case of a medium reproductive performance farm. Assuming that the farmer will require to produce enough on-farm replacements, the farmer would select the dashed circled area in Figure 3 as a subset of possible strategies. Within these strategies, it is likely that the farmer would like to maximize the ICOSC, which will happen when using a combination of maximum sexed semen (2C) with maximum use of beef semen (100%) resulting in the maximum ICOSC of $2,001 with 2 extra replacements (FCB=2). Theoretically, the farmer could have greater ICOSC by using less sexed-semen (maximum of $7,150 when NS and 100% beef), but that would imply a large replacement deficiency. The assumption that the farmer would be able to buy replacements for in the market as needed might not be realistic, practical, or feasible in all the cases. Farmers would normally prefer to produce their own replacements, which counterbalance the economic opportunity of using beef semen and capitalizing on the high prices of beef crossbred calves.

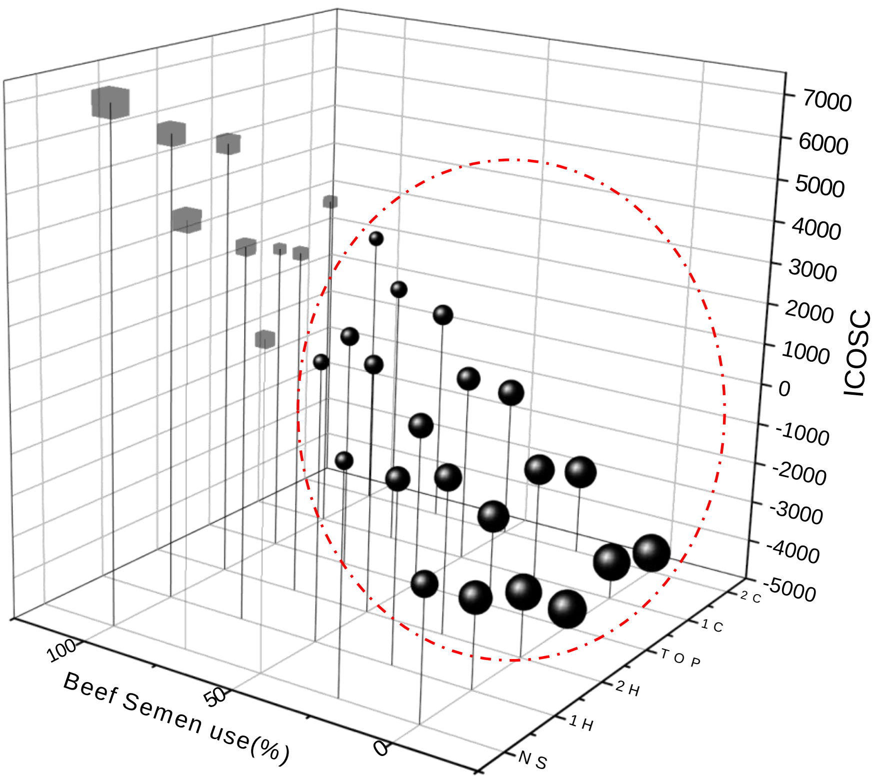


Figure 3. Income from calves over semen cost, ICOSC, and female calves balance, FCB, for medium reproductive level under current Wisconsin market conditions. The solid sphere represents positive FCB (the bigger the sphere, the greater the positive FCB); the shallow cube represents negative FCB (the bigger the cube, the greater the negative FCB).

Table 4. Best sex-sorted semen utilization (Best SS): no sexed semen (NS); 1st service in heifers (1H); 1st and 2nd services in heifers (2H); 1st and 2nd services in heifers and 20% cows with top-genetic at each service (TOP); 1st and 2nd services in heifers and 1st service in primiparous cows (1C); and 1st and 2nd services in heifers and 1st service in primiparous and second-parity cows (2C). Best percentage of beef semen utilization in the remaining adult cows (% Beef) and femal calves balance (FCB) for highest income from calves over semen cost (ICOSC) under different simulation scenarios and reproductive performances.

					Reproductive Performances											
	Calf Prices				Low				Medium				High			
Scenarios	PHF[1] ($/calf)	PHFS[2] ($/calf)	PHM[3] ($/calf)	PB[4] ($/calf)	Best SS	% Beef	ICOSC	FCB	Best SS	% Beef	ICOSC	FCB	Best SS	% Beef	ICOSC	FCB
Highest ICOSC																
Wisconsin current market prices[5]	45	45	57.5	225	NS	100	5704	-28	NS	100	7150	-16	NS	100	7450	-5
Decreaing PB $125	45	45	57.5	100	NS	100	-749	-28	NS	100	704	-16	NS	100	1716	-5
Decrease PB $45	45	45	57.5	180	NS	100	3381	-28	NS	100	4829	-16	NS	100	5386	-5
Increasing PB $75	45	45	57.5	300	NS	100	9576	-28	NS	100	11017	-16	NS	100	10890	-5
Increasing PB $175	45	45	57.5	400	NS	100	14738	-28	NS	100	16174	-16	NS	100	15478	-5
Increasing PHF $55	100	100	57.5	225	NS	100	4166	-28	NS	100	6289	-16	NS	100	7149	-5
Increasing PHF $100	145	145	57.5	225	NS	100	2907	-28	NS	100	5584	-16	NS	100	6902	-5
Increasing PHFS $180	145	225	57.5	225	2H	100	3561	-22	2H	100	6538	-8	2H	100	8227	4
Increasing PHF $255	300	300	57.5	225	2H	100	-1236	-22	2H	100	3525	-8	2H	100	6643	4
Increasing PHFS $355	300	400	57.5	225	2C	100	425	-12	2C	100	5796	2	2C	100	9582	14
Decreasing PHM and PB to $150	300	400	150	150	2C	0	1309	6	2C	0	6900	20	2C	0	10756	29
Increasing PHM $42.5	45	45	100	225	NS	100	6610	-28	NS	100	8282	-16	NS	100	8757	-5
Decreasing PSS[6] $15	45	45	57.5	225	NS	100	5704	-28	NS	100	7150	-16	NS	100	7450	-5
Decreasing PBS[7] $5	45	45	57.5	225	NS	100	8643	-28	NS	100	9633	-16	NS	100	9281	-5
Increaseing PBS $10	45	45	57.5	225	NS	100	2765	-28	NS	100	4667	-16	NS	100	5619	-5
decreasing PCS[8] $10	45	45	57.5	225	NS	100	6684	-28	NS	100	8186	-16	NS	100	8547	-5
Increasing PHF purchased[9] by $45	45	45	57.5	225	NS	100	3594	-28	NS	100	5382	-16	1H	100	6215	1

[1]PHF: Price of Holstein female calf. [2]PHFS: Price of Holstein female calf coming from sexed semen.[3]PHM: Price of Holstein male calf. [4]PB: Price of beef crossbreed calf. [5]Wisconsin current market prices: market prices were averaged acoording to Stratford Market Report (12/04/2018), www.equitycoop.com. [6]PSS: Price of a dose of sex-sorted semen. [7]PBS: Price of a dose of beef semen. [8]PCS: Price of a dose of conventional semen. [9]PHF purchased: Price of Holstein female calf purchased from the market.

Table 5. Best sex-sorted semen utilization (Best SS): no sexed semen (NS); 1st service in heifers (1H); 1st and 2nd services in heifers (2H); 1st and 2nd services in heifers and 20% cows with top-genetic at each service (TOP); 1st and 2nd services in heifers and 1st service in primiparous cows (1C); and 1st and 2nd services in heifers and 1st service in primiparous and second-parity cows (2C). Best percentage of beef semen utilization in the remaining adult cows (% Beef) and femal calves balance (FCB) for highest income from calves over semen cost (ICOSC) with positive FCB under different simulation scenarios and reproductive performances.

					Reproductive Performances											
	Calf Prices				Low				Medium				High			
Scenarios	PHF[1] ($/calf)	PHFS[2] ($/calf)	PHM[3] ($/calf)	PB[4] ($/calf)	Best SS	% Beef	ICOSC	FCB	Best SS	% Beef	ICOSC	FCB	Best SS	% Beef	ICOSC	FCB
Optimal ICOSC																
Wisconsin current market prices[5]	45	45	57.5	225	1H	0	-4094	0	2C	100	2001	2	1H	100	6215	1
Decreaing PB $125	45	45	57.5	100	1H	0	-4094	0	1H	0	-1167	3	NS	50	607	5
Decrease PB $45	45	45	57.5	180	1H	0	-4094	0	1H	50	493	2	1H	100	4151	1
Increasing PB $75	45	45	57.5	300	TOP	25	-3372	0	2C	100	4821	2	1H	100	9655	1
Increasing PB $175	45	45	57.5	400	TOP	25	-2339	0	2C	100	8581	2	1H	100	14242	1
Increasing PHF $55	100	100	57.5	225	1H	0	-4083	0	2C	100	2120	2	1H	100	6270	1
Increasing PHF $100	145	145	57.5	225	2C	25	-4033	1	2C	100	2217	2	1H	100	6316	1
Increasing PHFS $180	145	225	57.5	225	2C	25	-1850	1	2C	100	4812	2	2H	100	8227	4
Increasing PHF $255	300	300	57.5	225	2C	25	-3835	1	2C	100	2553	2	2H	100	6643	4
Increasing PHFS $355	300	400	57.5	225	2C	25	-1106	1	2C	100	5796	2	2C	100	9582	14
Decreasing PHM and PB to $150	300	400	150	150	1C	0	1323	5	2C	0	6900	20	2C	0	10756	29
Increasing PHM $42.5	45	45	100	225	1H	0	-2324	0	1H	50	2979	2	1H	100	7026	1
Decreasing PSS[6] $15	45	45	57.5	225	TOP	25	-2509	0	2C	100	3553	2	1H	100	6857	1
Decreasing PBS[7] $5	45	45	57.5	225	2C	25	-3552	0	2C	100	4028	2	1H	100	8046	1
Increaseing PBS $10	45	45	57.5	225	1H	0	-4094	0	1H	50	412	2	1H	100	4384	1
decreasing PCS[8] $10	45	45	57.5	225	1H	0	-485	0	1H	50	3567	2	1H	100	6884	1
Increasing PHF purchased[9] by $45	45	45	57.5	225	TOP	25	-2059	0	TOP	75	2559	4	1H	100	6215	1

[1]PHF: Price of Holstein female calf. [2]PHFS: Price of Holstein female calf coming from sexed semen. [3]PHM: Price of Holstein male calf.[4]PB: Price of beef crossbreed calf. [5]Wisconsin current market prices: market prices were averaged acoording to Stratford Market Report (12/04/2018), www.equitycoop.com. [6]PSS: Price of a dose of sex-sorted semen. [7]PBS: Price of a dose of beef semen. [8]PCS: Price of a dose of conventional semen. [9]PHF purchased: Price of Holstein female calf purchased from the market.

For optimal ICOSC (Table 5) with enough replacements available, all scenarios resorted to sex-sorted semen use for covering female calf deficiencies. There was a large numeric difference between highest ICOSC and optimal ICOSC for low reproductive performance from -28 and 0, respectively. Although the ICOSC includes the discounted value of the female calves required, the highest ICOSC purchases female calves outside to cover female calf deficiency. Nonetheless, it could fail to support itself because it depends on the availability of female calves in the market. Under default semen price scenario, using expensive sex-sorted semen to supply less valuable female calf replacement might not be sustainable (Figure 4).

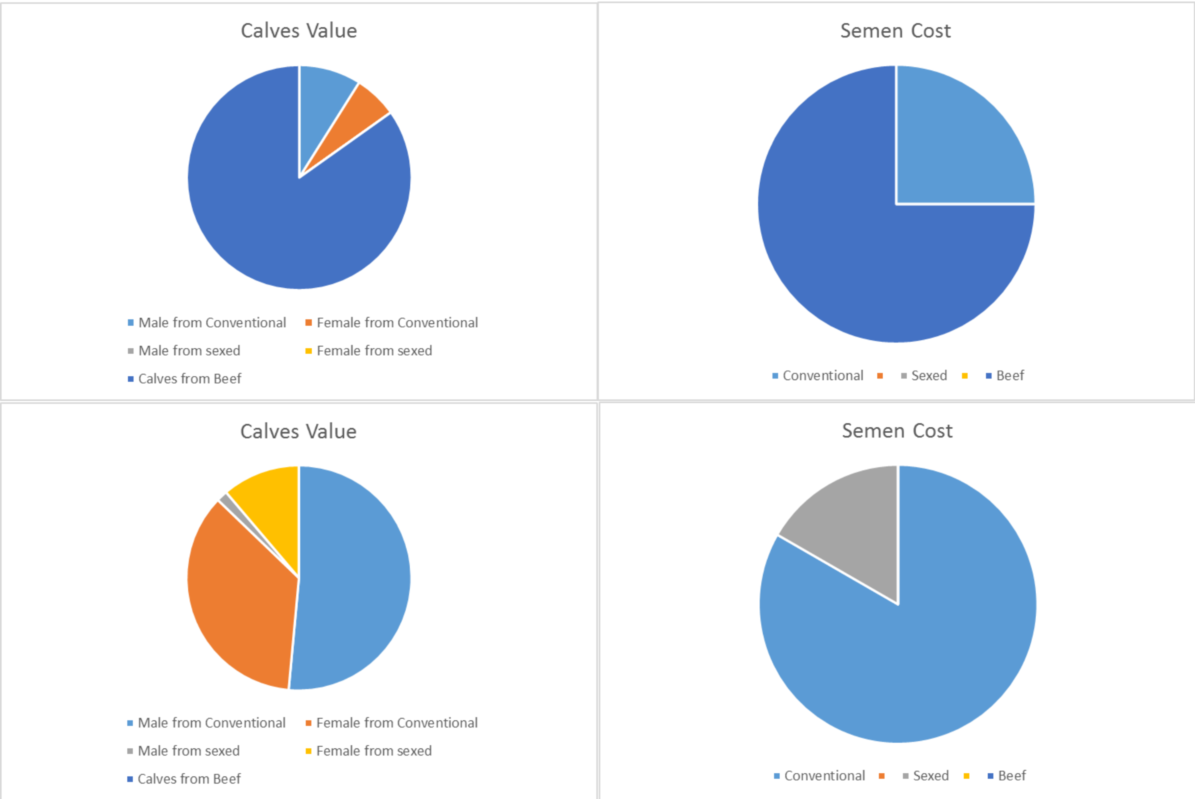


Figure 4. Proportions of income from claves over semen cost, ICOSC, components for non sexed semen use, NS, with 100% beef semen (top graphs) and sexed semen used in 1st service in heifers (1H) with 0% beef semen (bottom graphs) under low reproductive performance.

Increasing Price of Beef Crossbreeding Calf. The highest ICOSC (regardless of FCB) under current Wisconsin market conditions, is NS with 100% beef semen for adult cows (Table 4) whereas the one with the lowest ICOSC is NS with 0% beef semen use (data not shown). High reproductive performance determines the highest ICOSC in all strategies (Figure 1a), which is consistent with the relation between profit and reproduction. Nevertheless, the highest ICOSC was still below zero under current Wisconsin market conditions. The use of sex-sorted semen strategies did not improve ICOSC. On the other hand, in most situations, except for the scenario in low reproductive performance with NS strategy (FCB = -4), female calf balance was positive, FCB > 0. In all strategies with 100% beef semen inseminated to remaining adult cows (Figure 5), the ICOSC for medium reproductive level was very close to the ICOSC for high reproductive level and even the same at some points. However, most of these cases were at a negative FCB. This indicated that lower reproductive performance farms could improve ICOSC by sacrificing the replacement supply, which, to some extent, alleviate the negative effect of low reproduction and decreases the difference between different reproductive levels.

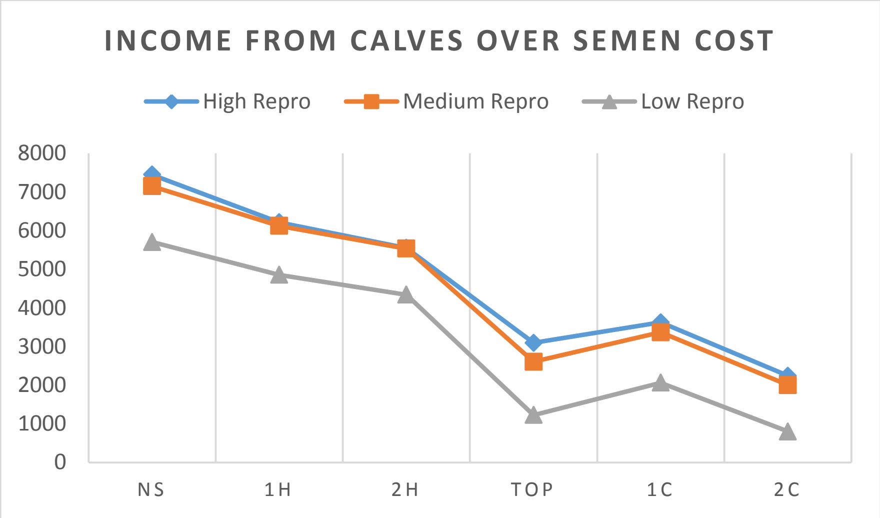


Figure 5. Income from calves over semen cost, ICOSC of different semen strategies with 100% beef semen in current Wisconsin market conditions.

Results of alternative plausible prices of beef calves when using 100% beef semen suggested that there was an apparent difference of ICOSC among different reproductive levels when the beef calf price is low (PB = $50), but as the beef calf price increased, the difference between high and medium reproductive levels decreased. Most parts of high and medium reproductive curves overlapped at PB = $300. High and low reproductive curves merged and medium reproductive curve became higher than the low and high reproductive at PB = $500. At greater beef calves, these dominate ICOSC and partially eliminate the effect of reproductive levels on ICOSC. Also, for lower reproductive herds, more bred eligible animals are available (more animals in non-pregnant status at more than 2 services) leading to more cows bred with beef semen producing more calves of greater value. Additionally, beef semen use need to be equiped together with sexed semen considering the negative replacement balance (Table 5), which was in agreement with Ettema et al. (2017).

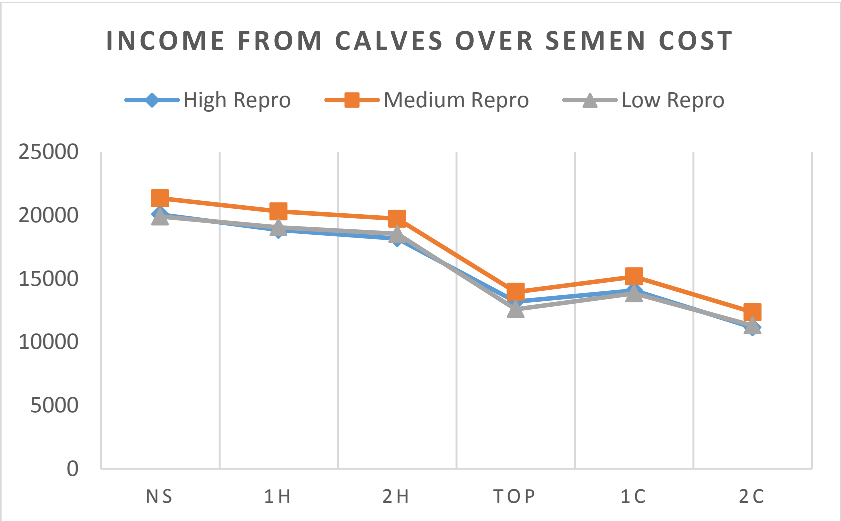


Figure 6. Income from calves over semen cost, ICOSC at $500 beef calf price under 3 reproductive levels.

Increasing Price of Holstein Female Calf. For low reproductive herds, none of the optimal semen strategies used beef semen more than 25%, whereas, for medium and high reproductive groups, 100% beef semen was the optimal alternative (Table 5). This is because of the extremely negative FCB for low reproductive herds that even the most female-producing strategies failed to cover the deficiency, leading to less beef semen use. It seems then that beef semen utilization is mainly limited by reproductive performance.

Increasing the price of Holstein female calves from conventional or sex-sorted semen increased the ICOSC, but optimal semen strategy remained unchanged. One reason for this result is that when cows and heifers are bred with conventional semen, there is always 53% low-value male calves produced, which to some degree, dilute the effect of the high price of Holstein female calves whether they are from conventional or sex-sorted semen. After increasing the price of Holstein male calf, the ICOSC for the 3 reproductive levels increased and tended to be positive with increased FCB.

Increasing the price of Holstein female calf purchased, mimicking a situation of low availability of female replacements in the market, caused more sex-sorted semen and less beef semen use for low and medium reproductive farms (Table 5). Even though more doses of sexed semen (108) were used for TOP than 2C strategy, 46% of the sexed semen was used to inseminate adult cows with more than 2 services and lower conception rates (data not shown). Low reproductive farms with negative FCB would be forced to purchase replacements even if these are expensive in the market.

Increasing Price of Holstein Male Calf. Increased PHM enabled low and medium reproductive farms to use less sexed and beef semen (Table 5), primarily because those 53% male calves from conventional semen were more valuable than before (their current low price contributed to more beef semen use). For high reproductive performance farms with usual positive FCB, the best strategy in terms of optimal ICOSC remained unchanged, which indicates that FCB related to reproduction performance is an important factor for farm economics.

Changing Semen Price. As expected, decreased sex-sorted semen price caused that low and medium reproductive performance farms used more sex-sorted semen to produce female calves for replacement and then more beef semen to produce valuable crosbred calves. Increased beef semen price stopped beef semen use for low and medium reproductive performance farms and decreased the optimal ICOSC for all reproductive levels, whereas decreased beef semen price had a positive impact on both. Decreasing the price of conventional semen, low and medium reproduction performance farms tended to use less sexed and beef semen. On the other hand, high reproduction farms were less sensitive to semen prices.

Conclusions

Given that present market circumstances, farms in all scenarios could benefit from using beef semen for adult Holstein cows. With the higher price of beef calf compared with price Holstein calves, low reproductive farms could obtain much higher ICOSC by sacrificing its replacement supply and purchasing replacements. However, the replacement availability should be taken into consideration. When considering the female calf balance, more beef semen utilization would need to be combined with more sex-sorted semen for lower reproductive farms. Reproduction performance becomes the primary limitation for beef semen use and capitalizing on gains from crossbred calves. The model updated here and the decision support tool available at the Dairy Management from the University of Wisconsin-Madison provides a comprehensive decision-making opportunity for farms in terms of optimal ICOSC, which would greatly change according to market, management, and technological conditions.

References

Cabrera, V. E. 2012. A simple formulation and solution to the replacement problem: A practical tool to assess the economic cow value, the value of a new pregnancy, and the cost of a pregnancy loss. Journal of Dairy Science 95:4683-4698

Ettema, J. F., Thomasen, J. R., Hjortø, L., Kargo, M., Østergaard, S., & Sørensen, A. C. 2017. Economic opportunities for using sexed semen and semen of beef bulls in dairy herds. Journal of Dairy Science 100:4161-4171.

Seidel, G. E. 2014. Update on sexed semen technology in cattle. Animal 8(SUPPL. 1):160-164. https://doi.org/10.1017/S1751731114000202.

Lopes, G., and, V. E. Cabrera. 2014. Premium beef semen on dairy calculator. J. Anim. Sci. 92 (E-Suppl. 2):288.

Mur-Novales, R. M., and V. E. Cabrera. 2017. What type of semen should I use? Proceedings Dairy Cattle Reproduction Council Annual Convention. Reno, NV 7-9 November 2017.