

## PRELIMINARY RESULTS OF UTILITY FOR WAGYU AND RED ANGUS BULL'S STRAW FROZEN SEMEN ON ZEBU CROSSBRED COWS IN THAI BINH PROVINCE, VIETNAM

*Pham Van Gioi<sup>1</sup>, Pham Van Tiem<sup>2</sup>, Dang Van Dung<sup>1</sup>, Vu Chi Thien<sup>1</sup> and Tran Thi Minh Hoang<sup>1</sup>*

<sup>1</sup>Animal Genetics and Breeding Department, NIAS, Ha Noi, Vietnam; <sup>2</sup>Department of Science and Technology for Economic technical Branches - Ministry of Science and Technology

Corresponding author: Pham Van Gioi; Tel: 0988486713; Email: Gioikhiet@gmail.com

### ABSTRACT

The objectives of this research were to investigate the conception rate, proportion of calving, calving status, gestation length in Zebu crossbred cows artificially inseminated with Wagyu and Red Angus bull's straw frozen semen, in Thai-Binh Province, from June 2019 - March 2021. Total of 236 Zebu crossbred cows were chosen, inseminated, and monitored for conception, pregnant status, calving, and gestation length. The conventional researching methods, data collection in accordance with rural conditions were applied. Minitab software version 16 and SAS (9.4) were utilized for data analyses. Proc Descriptive Statistics was utilized for analyzing the continuous data. The categorical and nominal data were analyzed by Proc Table. Logistics regression with binary was used to evaluate factors affecting the results of artificial inseminations. The results showed that the common conception rate of cows inseminated with Red Angus and Wagyu semen was 51.00%, in which 48.00% and 54.00% for cows inseminated with Red Angus and Wagyu semen, respectively. Successful calving proportion of cows acquired 78.91%, in which 75.76% when they were inseminated with Red Angus semen and 81.48% with Wagyu bull's semen. Parity and cows' breeds were associated with calving difficulty of Zebu crossbred cows when they were inseminated with Red Angus and Wagyu bull's semen ( $P < 0.05$ ). It is concluded that Zebu crossbred cows in this region were eligible to be inseminated with Wagyu and Red Angus bulls' semen to create the highly yielded beef calves in accordance with rural management conditions, adapted with tropical and coastal climate as in Thai-Binh province of Vietnam.

**Keywords:** *Zebu crossbred, Wagyu cattle, Red Angus cattle, conception rate, calving difficulty and ease.*

### INTRODUCTION

Thai Binh province is pastoral plain zone locates in Northern coastalline of Vietnam, the area with quite developed beef production, cattle population reached up to nearly 50 thousand heads (Vietnam statistics, 2021). It ranks thirdly for beef cattle production in Red River Delta region, only stood below Hanoi Capital and Vinh Phuc Province. Here, majority of breeding stock is mixture of Red Sindhi crossbreds (RSC) or Red Brahman crossbreds (RBC) ( $F_1$ : 50% RSC and 50% Red Brahman) with much bigger body weight and stature in comparison to previous indigenous yellow cattle. So, it seemed to be convenient to utilize and apply highly yielded beef bovine genotypes to upgrade both beef quality and productivity as well as competitiveness in commercially beef production for this region. Besides, with available comparative advantages in vast natural freeland, fertile alluvial soil, and abundant village labour force will facilitate to cultivate and develop the highly productive, nutrient enriched grasses and forage, will accelerate high-yielding beef cattle production.

Wagyu (WG; Japanese black cattle) is an especially renowned breed of beef quality and price in the world. It possesses high marbling score, tasty flavour results from even distribution of white fat with red muscular fibers, Japanese beef is so tender that nearly melts in the mouth (Lunt et al., 1993; Mears et al., 2001; Radunz et al., 2009; Gotoh et al., 2018; Liu et al., 2021). Besides that Red Angus (RA) is a cattle breed of little costly, little diseases,

considerable economics for breeders. Beef of Red Angus possesses the bright red, light colours, mainly known as a food with high value, quality, with white fat alternates with red beef fibers it makes beef more tender and have a very pleasant fatty taste. On the other hand, Red Angus cattle is able to get high reproduction and early matured, easy to raise and in accordance with tropically pedologic soil land (Red Angus Cattle).

In order to utilize the genetic resources from these two beef breeds for crossbreeding with Zebu crossbreds, create new crossbreds to produce the beef with high productivity and quality and contribute into the success of value chain in beef production in Thai Binh province, it is necessary to investigate the preliminary results of insemination and monitoring pregnancy on Zebu crossbred cows utilizing Wagyu and Red Angus bull's straw frozen semen.

## **MATERIALS AND METHODS**

### **Location and time**

The research was carried out in Vu Thu district, Thai Binh Province from 2019 to 2021.

### **Experimental design and methods**

236 Zebu crossbred cows (15 heifers and 221 cows), out of which 177 Red Sindhi crosses (RSC) and 59 Red Brahman crosses (RBC) derived from 145 households, in Vu Thu district, Thai Binh province; some their performance traits was shown in Table 1; 150 Wagyu bulls' straw frozen semen doses imported from USA; 150 Red Angus bull's straw frozen semen doses made in Vietnam, produced from NIAS, Vietnam. Materials for estrous induction and AI (instruments for AI, applicators, Hormone GnRH, PGF<sub>2α</sub>, rubber gloves, cryopreservation jar for fluid nitrogen, labour clothes, ...) were available for this investigation.

559 Zebu crossbred females were surveyed, evaluated, 434 females were chosen, and 236 females were artificially inseminated. Breed group of RSC and RBC were distinguished based on appearance characters and pedigree records from farmers and local Inseminators. The conventional methods were applied for the research (measurement, observation, interview the holders).

The criteria for chosen females as following: Nice appearance (Characteristically red coat colour and frame of Zebu crossbreds as Red Sindhi and Red Brahman crosses).

Heifers were older than 18 months of age; cows with good reproductive records

Body weight: greater 200 kg.

Free infectious transmitted disease or reproductive disorders

Insure eligibility for estrous induction and AI

*Choices of eligible Red Angus and Wagyu bulls' straw frozen semen.*

Bulls' straw frozen semen with clear pedigrees and highly productive potential of growth and beef quality were chosen for inseminations. Cows were randomly assigned for semen in AI by technician.

Table 1. Descriptive statistics for Zebu crossbred females inseminated with Wagyu and Red Angus bulls' frozen semen

Traits	Breed groups	N	Mean	SD	Min	Max
Ages (Years old)	RBC	59	6.52	1.81	3	11
	RSC	177	6.64	2.64	2.5	20
	Pooled	236	6.61	2.45	2.5	20
Parities (calvings)	BrC	59	2.75	1.46	0	5
	RSC	177	3.14	2.26	0	14
	Pooled	236	4.04	2.09	0	14
Body weight (kg)	BrC	59	341.03	28.68	300	420
	RSC	177	254.63	25.20	200	350
	Pooled	236	276.23	45.66	200	420

*Characteristics of region*

The investigation was carried out in Vu Thu district of Thai Binh Province. The location with area of 1,586.3 km<sup>2</sup> and locates in Red River Delta region, coastal line in the North of Vietnam. The climate was characterized by tropically hot-humid, monsoon and coastal conditions. Annual rainfall of 1.700 - 2.200 mm; average temperature of 23°C - 24°C, total annual active temperature reached to 8400 - 8500°C; humidity 80-90%; total annual sunshine duration: 1.600 - 1800 hours; land slope is about 1% and the average altitude of 1 - 2 m above sea level. Winter - Spring was from october this year to march next year, Summer - Autumn was from April to September annually.

*Cattle herd management*

Cattle were daily released in the freelands or pastures for grazing natural grasses and forage from 6 - 8 o'clock in the morning and returned their houses from 17 - 18 o'clock in the evening.

After 42 days of AI given, females do not expose estrous signs (or false estrus), they were treated and confirm as conception, and they were applied and managed with pregnant regimes and rations. After 60 days, they were examined by rectal palpations to confirm the positions of fetuses in uterine horns.

In pregnant period, at the time of confinement, cows were daily supplemented at barns with average 4.0 - 6.0 kg fresh grasses and 0.5 - 1.0 kg concentrate (maize powder, soybean meal, fish meal, rice bran and Vitamin mixture).

*Monitoring natural estrus, induction and artificial insemination with Wagyu and Red Angus semen.*

The natural estrus was monitored from onemonth-postnatal cows and based on physiologically estrous signs.

The active estrus was induced on cows after 3 months of calving but not appear returned estruses: Utility of Hormone and products: GnRH, PGF<sub>2α</sub>, CIDR (Ha et al., 2018).

Heifers and cows exposed estrous signs were actively observed and AI performed by more than 10 year experienced technicians, with good reputation.

Conception rate, un-succesful calving proportion, calving status were computed used the following formulae (Cai, 2007; Scheifers et al., 2010).

$$CR(\%) = \frac{NPC}{NIC} \times 100\%$$

*Where:*

*CR(%): Conception rate %*

*NPC: Number of pregnant cows (Conceived cows)*

*NIC: Total number of artificial inseminations (The same cow inseminated in different estrous cycles was treated as different inseminations).*

*Monitoring pregnancy and calving*

Females were confirmed pregnant when they were not returned estrus after 42 days of AI given (or false estruses were found).

Monitoring calvings. After 260 days of pregnancy, cows were separated from herds and continuously observed for calving diagnoses. Cows were determined as successful calving when they exposed physiologically calving signs and newborn calves were still alive over 24h from birth. Whereas, females were determined as unsuccessful calvings when they got aborted, still birth, foetal losses, dead foetuses, neonatal calves died at calvings.

Successful calving proportion was computed using the formula:

$$PC(\%) = \frac{NC}{NP} \times 100\%$$

*Where:*

*PC(%): Proportion of successful calving %*

*NC: Number of successfully calved cows*

*NP: Number of pregnant (Conceived)cows*

Unsuccessful calving proportion was computed using the formular:

$$PUC(\%) = \frac{NUC}{NP} \times 100\%$$

*Where:*

*PUC(%): Proportion of unsuccessful calving %*

*NUC: Number of unsuccessful calvings (Aborted, stillbirth, foetal losses or pregnant losses)*

*NP: Number of pregnant cows (Conceived cows)*

*Discriminations of calving difficulty and ease:*

Category of calving difficulty and ease

Classes	Descriptions
Calving ease	Cows calved in completely natural style or they were assisted in calving with very lowly pulled force
Calving difficulty	Cows calved in difficult status, they were much assisted from technicians to pull out the fetuses.

Proportion of calving difficulty was computed using the following formula:

$$PCD(\%) = \frac{NCD}{NC} \times 100\%$$

Where:

*PCD(%)*: Proportion of calving difficulty %

*NCD*: Number of cows suffered from calving difficulty

*NC*: Number of successful calvings

**Data analyses**

Records were prepared and formatted in Excel (2016), analyzed by the software of MINITAB16 version (2010). Categorized data were analyzed in Proc Table, compared in Chi-square procedure. Continuous data analyzed by ProcDescriptive Statistics. Probability level of 0.05 applied as critical value.

Besides, multiple binary logistics regression model was also applied for analyzing the effects of some factors on conception rate of cows. Proc Logistics regression in SAS 9.4 was following.

$$Logit(\pi) = \beta_0 + \beta_1 BS_{i_l} + \beta_2 BC_{2_j} + \beta_3 P_{3_k} + \beta_4 Sex_{4_l} + e; \quad Logit(\pi) = \ln\left(\frac{P = CD}{P = CE}\right)$$

Where: *Logit(π)* represented logistics function

$\beta_0$  is constant

$\beta_1$ : is slope for Breeds of semen

$BS_{i_l}$ : is the  $i^{th}$  factor for breeds of semen ( $i=2$ : Wagyu and Red Angus)

$\beta_2$ : is slope for cows' breed group

$BC_{2_j}$ : is the  $j^{th}$  factor for cows' breed group ( $j=2$ : RBC and RSC)

$\beta_3$ : is slope for parity

$P_{3_k}$ : is the  $k^{th}$  factor for parity ( $k=2$ : Heifers and first parity; second parity or more)

$\beta_4$ : is slope for sex of calf

$S_{4_l}$ : is the  $l^{th}$  factor for sex of calf ( $l=2$ : Male and Female)

*e*: is random errors

*P=CD*: Probability of event (Probability of calving difficulty),

*P=CE*: Probability of reference variable (probability of calving ease).

## RESULTS AND DISCUSSION

### Pregnantly inseminated and Conception rates

In total of 236 artificially inseminated females; in which 119 were inseminated with Wagyu bull's frozen semen and 117 with Red Angus bull's frozen semen. In group of females inseminated with Wagyu semen, 81 females get conceived and 38 females failed in pregnancy, accounted for pregnantly inseminated rate of 68.07%; whereas the group was inseminated with Red Angus semen, 72 females get pregnant, 45 females failed in pregnancy, accounted for 61.54% of pregnancy. Commonly, in 236 inseminated females, 153 females get pregnant and 83 females failed in pregnancy, proportion of females got pregnantly inseminated was 64.83% (Table 2).

Table 2. Inseminated females and proportion of pregnantly inseminated females by two breeds of semen

Breeds of frozen semen	Items	Pregnancy	Non-pregnant	Total of females by breeds
Wagyu	Number of inseminated females	81	38	119
	percentage %	68.07	31.93	
Red Angus	Number of inseminated females	72	45	117
	percentage %	61.54	38.46	
<b>Total of females by results</b>	<b>Number of inseminated females</b>	<b>153</b>	<b>83</b>	<b>236</b>
	<b>percentage %</b>	<b>64.83</b>	<b>35.17</b>	

The results in different inseminations indicated that, the first insemination, the conception rate of females inseminated with Wagyu semen was 50.42%, higher than the rate for females inseminated with Red Angus semen was 44.44%; in second insemination, conception rate of females inseminated with Wagyu semen was 70.37%, higher than the rate of females inseminated with Red Angus semen was 59.38%; in the third insemination, conception rate of females inseminated with Wagyu semen was 50%, and one females left was conceived with Red Angus semen. In overall, conception rate of females inseminated with Wagyu semen was 54.00%, and higher than the rate for females inseminated with Red Angus was 48.00%. Otherwise, in common for both breeds of semen inseminated in Zebu crossbreds, the results showed that in the first insemination, the conception rate was 47.46%; in second insemination the conception rate was 64.41%; in the third insemination the conception rate was 60.00%; the overall conception rate was 51.00% (Table 3). In the first insemination, the second and the total insemination, the results indicated that the conception rates of females inseminated with Wagyu semen were higher than the rate of Red Angus semen, however, no statistically significant differences were found among them ( $P>0.05$ ).

Table 3. Conception rates of Wagyu and Red Angus bull’s semen in different inseminations

Breeds of semen	Insemination 1			Insemination 2			Insemination 3			Total of inseminations		
	Number of inseminated	Number of pregnant females	Conception rate (%)	Number of inseminated	Number of pregnant females	Conception rate (%)	Number of inseminated	Number of pregnant females	Conception rate (%)	Number of inseminated	Number of pregnant females	Conception rate (%)
WG	119	60	50.42 <sup>a</sup>	27	19	70.37 <sup>a</sup>	4	2	50.00	150	81	54.00 <sup>a</sup>
RA	117	52	44.44 <sup>a</sup>	32	19	59.38 <sup>a</sup>	1	1	100.00	150	72	48.00 <sup>a</sup>
<b>Total of breeds</b>	<b>236</b>	<b>112</b>	<b>47.46</b>	<b>59</b>	<b>38</b>	<b>64.41</b>	<b>5</b>	<b>3</b>	<b>60.00</b>	<b>300</b>	<b>153</b>	<b>51.00</b>

Notes: In the same column of conception rate, the values with the same abbreviated letter superscript indicated that no statistically significant difference between them (P>0.05).

When conception rates in different seasons mentioned, the results showed that for Wagyu semen, conception rate in Summer-Autumn was 57.14%, which was higher than in Winter-Spring of 52.78%, however, significance between them was not statistically significant (P>0.05). Whereas, when Red Angus semen was inseminated in Winter - Spring, its conception rate was 49.00%, which was higher than in Summer - Autumn of 46.00%, but, the significance between them was also not statistically significant (P>0.05).

In the same season, the significance of conception rate between two breeds of semen was also no statistically significant (P>0.05); 52.78% of Wagyu semen versus 49.00% for Red Angus semen in Winter - Spring; 57.14% for Wagyu semen versus 46.00% for Red Angus semen. Commonly, conception rates for both of two semen breeds were 50.96% in Winter-Spring, a bit lower in Summer - Autumn of 51.09% (P>0.05).

Table 4. The results of inseminations for two breeds of Wagyu and Red Angus semen on Zebu crossbred cows by different seasons

Breeds of semen	Parameters	Winter - Spring	Summer- Autumn	Total of seasons
Wagyu	Number of pregnant females	57	24	81
	Total of inseminations	108	42	150
	Conception rates (%)	52.78 <sup>a(I)</sup>	57.14 <sup>a(I)</sup>	54.00
Red Angus	Number of pregnant females	49	23	72
	Total of inseminations	100	50	150
	Conception rates (%)	49.00 <sup>a(I)</sup>	46.00 <sup>a(I)</sup>	48.00
<b>Total of breeds</b>	<b>Number of pregnant females</b>	<b>106</b>	<b>47</b>	<b>153</b>
	<b>Total of inseminations</b>	<b>208</b>	<b>92</b>	<b>300</b>
	<b>Conception rates (%)</b>	<b>50.96<sup>a</sup></b>	<b>51.09<sup>a</sup></b>	<b>51.00</b>

Note: In the same row, the values with the same abbreviated superscript letters were not statistically significant difference (P>0.05). In the same column, the values with the same abbreviated Roman letters were not statistically significant difference (P>0.05).

### Successful and unsuccessful calvings

Conceived females with Wagyu semen arose 15 females failed in pregnancy and 66 pregnant females successfully calved, accounted for 81.48% of successful calving proportion; whereas pregnant females with Red Angus semen showed that 16 aborted and stillbirth and 6

conceived females were missed due to movement and trafficking, 50 pregnant females successfully calved, accounted for 75.76% of successful calving proportion. In common, for both two breeds of semen, in total of 153 pregnant females, 116 pregnant females got successfully calved, accounted for 78.91% of successful calving proportion. Successful calving proportion with Wagyu semen was higher than with Red Angus semen, however, they did not differ significantly ( $P>0.05$ ).

Table 5. Results of pregnant status and successful calvings of Zebu crossbreds when they were inseminated with Wagyu and Red Angus semen

Breeds of semen	Missing (Conceived females)	Unsuccessful pregnancy (Conceived females)	Successful calving (Conceived females)	Total of pregnant females (Conceived females)	Proportion of successful calving (%)
WG	0	15	66	81	81.48 <sup>a</sup>
RA	6	16	50	72	75.76 <sup>a</sup>
<b>Total</b>	<b>6</b>	<b>31</b>	<b>116</b>	<b>153</b>	<b>78.91</b>

Notes: in The same column, the values with the same abbreviated superscript letter, they were not statistically significant difference ( $P>0.05$ ).

Proportion of unsuccessful calving in Zebu crossbred females when they were inseminated with Wagyu was 18.52%, and with Red Angus was 24.24%, pooled proportion for two breeds was 21.09%. By the breed group of females, proportion of unsuccessful calving for RBC was 10.64%, which was statistically lower ( $P<0.05$ ) than the breed group for RSC (26.00%). In the group inseminated with Wagyu semen, proportion of unsuccessful pregnancy for breed group of RBC females was 14.71%, which was lower than RSC breed group (21.28%), but they were not statistically significant difference ( $P>0.05$ ). In Breed group of females inseminated with Red Angus semen, RBC conceived females were not aborted or stillbirth, but the group of RSC got the unsuccessful proportion of pregnancy 30.19% (Table 6).

Table 6. Results of pregnant status by some factors when they were inseminated with two breeds of semen

Factors	Subclasses	Number of females successful calved	Total of pregnancy (females)	Unsuccessful pregnancy (females)	Proportion of unsuccessful pregnancy (%)
Breeds of semen	WG	66	81	15	18.52 <sup>a</sup>
	RA	50	66	16	24.24 <sup>a</sup>
	<b>Total</b>	<b>116</b>	<b>147</b>	<b>31</b>	<b>21.09</b>
Breed groups of females	RBC	42	47	5	10.64 <sup>a</sup>
	RSC	74	100	26	26.00 <sup>b</sup>
	<b>Total</b>	<b>116</b>	<b>147</b>	<b>31</b>	<b>21.09</b>
Wagyu	RBC	29	34	5	14.71 <sup>a</sup>
	RSC	37	47	10	21.28 <sup>a</sup>
	<b>Total</b>	<b>66</b>	<b>81</b>	<b>15</b>	<b>18.52</b>
Red Angus	RBC	13	13	0	0.00
	RSC	37	53	16	30.19
	<b>Total</b>	<b>50</b>	<b>66</b>	<b>16</b>	<b>24.24</b>



In this research, in total of 116 successful calvers, in which 53 calvers suffered from difficult calvings, assisted in pulling out the fetuses, accounted for difficult calving proportion of 45.69% (Table 7). As the results, the females inseminated with Red Angus semen, proportion of calving difficulty amounted to 54.00%, higher than when they inseminated with Wagyu semen (39.39%), but the difference between them was not statistically significant ( $P>0.05$ ). By the female breed groups, difficult calving proportion for RBC makes up 19.05%, which was significantly lower ( $P<0.05$ ) than the proportion for RSC (60.81%). On the other hand, for the both of two semen breeds, the first calving or second calving cows exposed the difficult calving proportion of 64.29%, which was significantly higher ( $P<0.05$ ) than the proportion of cows got three or more calvings (39.77%). The reason for this results was that the younger and RSC cows possessed the smaller stature and body weight, their pelvics were smaller in size than RBC cows.

Table 7. The results of monitoring the calving difficulty

Factors	Subclasses	Number of cows suffered from calving difficult (Cows)	Number of successful calving cows (Cows)	Proportion of difficult calving (%)
Breeds of semen	Wagyu	26	66	39.39 <sup>a</sup>
	Red Angus	27	50	54.00 <sup>a</sup>
Breed groups of females	RBC	8	42	19.05 <sup>a</sup>
	RSS	45	74	60.81 <sup>b</sup>
Parities of cows	Parity 1 and 2	18	28	64.29 <sup>a</sup>
	Parity 3 and more	35	88	39.77 <sup>b</sup>
<b>Common total</b>		<b>53</b>	<b>116</b>	<b>45.69</b>

Semen of two breeds inseminated in Zebu crossbred cows, the results showed that the likelihood that the cows suffered from calving difficulty was significantly lower ( $P<0.05$ ) when they calved three parities or more; was also significantly lower ( $P<0.05$ ) when the breed group of cows was RBC; was not significantly lower ( $P>0.05$ ) when the semen breed of bulls was Wagyu; was not significantly lower ( $P>0.05$ ) when the sex of calf was female (Table 8). Otherwise, the estimated odds ratio for parities of cows indicated that the odds of suffering from calving difficulty for the cows calved three times or more is equal 0.30 times versus cows calved parity 1 and 2; it means that the odds of calving difficulty for cows calved three times or more was 70% lower than cows calved the first or second parities. Similarly, the estimated odds ratio for cow breed groups showed that the odds of suffering from calving difficulty for RBC is equal 0.14 times versus RSC (or 86% lower than RSC); the cows inseminated with Wagyu semen is equal 0.82 times versus the cows inseminated with Red Angus semen; the cows conceived female calves is equal 0.57 times versus the cows conceived male calves;

Table 8. Some factors related to calving difficulty

Contrasts	Parameters	E±SE <sub>E</sub>	Confidence Limits (95%)		Wald Chi-Square	Pr > ChiSquare
			Lower	Upper		
<b>Parities of cows</b> [Parity 3+/(Parity 1 and 2)]	Likelihood Parameter	-1.21±0.52	-2.23	-0.20	5.47	0.0194
	Odds Ratio	0.30±0.15	0.11	0.82	5.47	0.0194
<b>Cows' breed group</b> (RBC vs RSC)	Likelihood Parameter	-1.97±0.49	-2.93	-1.00	16.06	<.0001
	Odds Ratio	0.14±0.07	0.05	0.37	16.06	<.0001
<b>Breeds of semen</b> (Wagyu vs Red Angus)	Likelihood Parameter	-0.19±0.43	-1.04	0.65	0.20	0.6513
	Odds Ratio	0.82±0.35	0.35	1.91	0.20	0.6513
<b>Sexes of calves</b> (Female vs Male)	Likelihood Parameter	-0.56±0.44	-1.42	0.30	1.65	0.1993
	Odds Ratio	0.57±0.25	0.24	1.34	1.65	0.1993

Notes: E: Estimated value; SE<sub>E</sub>: Standard error of estimated value; Parity 3+: Cows calved three parities or more; Parity 1 + 2: Cows calved first or second parity.

When cows inseminated with Wagyu semen, they conceived 281.49 days, in which the female fetuses were conceived 281.77 days, and longer than male calves of 281.49 days. Whereas, when they were inseminated with Red Angus semen, they conceived 279.10 days, in which female fetuses were conceived 280.32 days, and longer than male fetuses of 278.14 days. The average for gestation length on cows inseminated with two semen breeds, the results indicated that cows got conceived 280.47 days; 281.21 days when cows conceived female and 279.77 days for male calves (Table 9). Besides, the results showed that the shortest gestation length was 263 days for the cow conceived male fetuses and inseminated with Red Angus semen; the longest gestation length was 296 days and was found in cow conceived female fetuses and inseminated with Wagyu semen. Especially, it appeared a twinning calving with one male and one female calf, the proportion accounted for 0.86%

Table 9. Gestation length of Zebu crossbred cows when get inseminated with Wagyu and Red Angus bull's straw frozen semen

Breeds of semen	Sexes of calves	N	Mean±SD	Min	Max
WG	Female	35	281.77±5.30	270	296
	Male	32	281.19±5.28	264	290
	<i>Pooled</i>	67	281.49±5.26	264	296
RA	Female	22	280.32±6.41	270	296
	Male	28	278.14±5.16	263	286
	<i>Pooled</i>	50	279.10±5.79	263	296
<i>Both breeds</i>	<i>Female</i>	57	281.21±5.74	270	296
	<i>Male</i>	60	279.77±5.40	263	290
	<i>Pooled</i>	117	280.47±5.59	263	296

## General discussion

In this work, the conception rates on Zebu crossbred cows were 54.00% and 48.00%, respectively for Wagyu and Red Angus semen; and common conception rate for both semen breeds was 51.00%. Conception rate of Wagyu semen was a little better than that of Red Angus due to the cost of Wagyu semen and its merit, sometimes the good cow were also chosen for AI. In our viewpoint, this result was moderate due to the investigation was performed in rural conditions with tropical and coastal climate in the North, moreover, Zebu crossbred cattle herds were nourished and managed by holders, and mainly used poorly nutrient natural grasses and forage. However, commonly, the results of this research were lightly lower than the previous findings from some researchers in other areas and Red River Delta region of Vietnam. Conception rate of dairy crossbred bulls' semen (3/4HF and 7/8HF) artificially inseminated in dairy crossbred cow herds were 62.0% and 56.3%, respectively; and common conception rate was 60.0% (Gioi et al., 2006). Hoang Kim Giao and Phan Le Son (2003) reported used VILALICA frozen semen to inseminate into dairy cow herds in Northern provinces with conception rates acquired from 43.0 - 65%; Holstein Friesian dairy crossbred cows in Ba Vi – Ha Noi got conception rates in the range of 48.75 - 60.0% (Vinh et al., 2005); in which the results of this research were in the ranges. The conception rates of purebred Drought Master and Brahman cows produced in Hochiminh were 68.97% and 73.53%, respectively (Tuyen et al., 2008). Vinh et al. (2021) reported that BBB frozen semen inseminated in Zebu crossbred cow herds in Bac-Ninh province with common conception rate was 66.45% and ranged from 60.78% to 73.91%. Brahman frozen semen inseminated in Ha Noi, Thanh Hoa, Nghe An got conception rate of 68.6% (Hai, 2013). All above mentioned results were much higher than this research, the major reasons may result from their cow herds were almost managed in intensive systems with better conditions and technics were applied, and evenly better experienced technicians handle AI skills.

However, this results were involved in the ranges of some other works in several other countries. In Bangladesh, Siddiqui et al. (2012) reported that the conception rate in dairy herd was  $50.7 \pm 1.9\%$ , which was similar to this research. Conception rate when inseminate Angus semen into HF cows in USA ranged from 33.77% to 52.96% (McWhorter et al., 2020). Conception rate of Angus semen inseminated into Nelore cows was 50.0% (Pereira et al., 2021). Haruka Ukita et al. (2022) used HF and Japanese Black semen in two types and showed that conception rate with sexed semen ranged from 30.9% to 51.9%; with conventional semen from 39.3% to 62.4%. The conception rate with Wagyu semen were 40.5% to 60.2%, respectively for primiparous and multiparous cows; higher than the conception rates of HF semen, 34.1% in primiparous cows and 54.3% in multi parous cows. The conception rates were also varied in insemination months.

Tadesse et al. (2022) showed that the conception rate in Ethiopian cattle was 58.97%, ranged from 56.14% to 60.12% in different seasons, however, no statistically significant differences in seasons were found. It only existed the significant differences in breed groups of cows. Also, conception rates in inseminations differed no statistical significance. Which were similar to these findings (i.e.) no effects of seasons, only effects of cow breeds in inseminations on conception rates.

The gestation length of Zebu crossbred cows inseminated with Wagyu and Red Angus bulls' semen was shorter than purebred Droughtmaster (287.8 days, and ranged from 265 - 306

days) and purebred Brahman cows (286.2 days, and ranged from 266 - 296 days) nourished in Ho Chi Minh city (Tuyen et al., 2008), which were longer than this research.

Gestation length of cows in this research was partly similar to the findings in Australia, the calves were sired by Wagyu bulls got the average gestation length of 282.7 days; sired by Angus bulls got the gestation length of 281.5 days (Hearnshaw et al., 2001). The results of this research were also in accordance with Cundiff et al. (1998), who reported that crossbred calves were sired by Angus got the gestation length of 283.2 days. However, the gestation length in this research was lower than calves sired by Piedmontese, 288.4 days (Hearnshaw et al., 2001); 287.3 days (Cundiff et al., 1998). The other researches also showed that the sexes of calf fetuses do not affect the gestation length (Barlow and O'Neil, 1978; Cundiff et al., 1998).

Casas et al. (2012) indicated that cows inseminated with Wagyu semen conceived 286 days, which was longer than other breeds (HF cows conceived 282 days; inseminated with European bulls conceived from 282 - 283 days). Cows conceived male fetuses, longer than female fetuses (284 days with male calves and 283 days with female calves).

Casas et al. (2012) indicated that calves from Swedish Red and White and Friesian got the shortest gestation length (282 days), in the mean while calves sired by Wagyu bulls got the longest gestation length (286 days); calves born from Hereford cows got the longest gestation length (284 days), in the meantime, calves born from Angus cows got the shortest gestation length (282 days).

The researched results in New Zealand dairy herds showed that the gestation length for male calves was averaged 282.7 days, which was longer than female calves 281.2 days; in first parity cows (279.5 days) shorter than second parity cows (280.8 days) (Donkersloot, 2014). Tadesse et al. (2022) showed that the average gestation length was  $277.5 \pm 6.34$  days, and ranged from 253.0 to 295.0 days.

In relation to cows' calving difficulty, the results in this research showed that the calving difficult proportion of Zebu crossbred cows inseminated with Red Angus semen was higher in cows calved first and second parities than cows calved third parity or more; the calving difficult proportion of RSC was higher than RBC. These results were in accordance with the findings from some other scientists those were calving difficulty was associated with cows' age and breeds (Smith et al., 1976; Brinks et al., 1973; Makarechian et al., 1982). Some other works revealed that cows' breed, calves' birth weight, sexes of birth calves, gestation length, dam weight at calving, breeds of sires were all related to calving difficulty (Bellows et al., 1971; Cundiff et al., 1980; Cundiff et al., 1981; Makarechian et al., 1982). Haruka Ukita et al. (2022) used semen of HF and Japanese Black (Wagyu) indicated that cows suffered from calving difficulty ranged from 3.55% to 5.83% depended upon calves' sex and bulls' semen breed.

The results from this research were also quite consistent with the findings of Naazie et al. (1989) i.e. proportion of normal calving (calving ease), without assistance, accounted for 68.9% and proportion of assisted cows was 31.1%, in which proportion of strong assistance or caesarian technics accounted for 7.2% in the population. The bigger birth calves, smaller dam weight at calving, the higher proportion of calving difficulty cows suffered from.

Non-genetic factors related to calving difficulty on cows included: Age and cows parity, seasons and years of calving, calves' birth place, feeding technics, reproductive disorders, calves' sexes and nutrition (Zaborski et al., 2009).

Proportion of calving difficulty in dairy cows was averaged 6.9%; it was gradually reduced from low to high parity, and from low to high body weight; Proportion of calving difficulty in single calving accounted for 6.5%, Proportion of calving difficulty in twinning calving made up 15.5%; male calving was more difficulty than female calving, and the higher calves' birth weight, the higher calving difficulty the cows got increased, seasons also affect calving difficulty of cows (Gaafar et al., 2011).

In this research, one cow twinned when she was inseminated with Wagyu semen, accounted for twinning calving of 0.86% in total herd and 1.52% in the group of Wagyu-semen inseminated cows, which was much lower than twinning calving proportion of some other researchers: twinning of HF in USA accounted for 4.2% (1.2% for primiparous cows and 5.8% for multiparous cows) (Silva Del Río et al., 2007); twinning of 1.1% in primiparous cows to 6.2% of multiparous cows (Cady and Van Vleck, 1978). Iranian dairy cows twinned 3.9%, proportion of twinning calving increased from primiparous cows (1.1%) to multiparous cows from fourth parity or more (5.7%) (Ghavi Hossein-Zadeh et al., 2008). Twinning in dairy cows was higher than in beef cows (4% to 5%) and strongly affected by age and dams' parities (Day et al., 1995; Komisarek and Dorynek, 2002).

## CONCLUSIONS

Zebu crossbred cows in this research were eligible to be inseminated with Wagyu and Red Angus bulls' semen to create the highly yielding beef calves in accordance with rural management condition, adapted with tropical and coastal climate as in Thai-Binh province of Vietnam, specifically:

The common conception rate of cows was 51.00%, in which 48.00% and 54.00% for Red Angus and Wagyu bulls' semen application, respectively.

Successful calving proportion of cows acquired 78.91%, in which 75.76% for insemination of Red Angus semen and 81.48% of Wagyu bulls' semen.

### Conflict of Interest statement

The authors declare that there are no conflicts of interest.

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***Opponent: Dr. Phung The Hai***