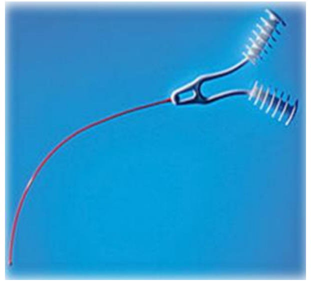
Economic return from use of fixed-time artificial insemination (FTAI) in a genetic improvement programme

Michael McGowan – School of Veterinary Science

Presentation outline

- Comparison of financial and genetic return on investment from using natural mating v’s FTAI
- Comparison of FTAI and AI following detection of oestrus
- Use of AI/FTAI to accelerate change in genotype
- What must be done to achieve a successful FTAI programme

Background



- Reproductive performance is a major driver of annual live-weight production in beef breeding herds
- Key fertility traits (age at puberty and interval from calving to re-conception) have recently been shown to be moderately heritable
- Using selection indexes that include the key production traits (fertility, growth, carcass) enables accurate identification of genetically superior sires
- Although AI has been widely used to drive rapid genetic improvement in the dairy industry its use in the beef industry has been limited except in countries such as Brazil
- In herds breeding their own replacement bulls AI of selected females can be a very effective method of achieving genetic improvement and change
- This presentation is based on the findings of a large study of FTAI conducted in northern Australia 2008-10
- For further details go to https://www.mla.com.au/research-and-development/search-rd-reports/final-report-details/Productivity-On-Farm/Strategies-to-increase-the-adoption-of-AI-in-northern-Australian-tropical-beef-genotype-herds

Estimating return on investment in FTAI

- Outcome of 3 breeding strategies were compared in a self-replacing Brahman herd of 200 cows:

1. natural mating – all bulls and cows are of average genetic merit (Brahman Jap Ox Index#)
- all bulls purchased
2. mate 40 cows to a purchased bull in top 10% for Brahman Jap Ox index
- remainder herd as for strategy 1
3. FTAI using semen from a bull in top 10% for Brahman Jap Ox index followed by natural mating

#The Jap Ox Index estimates the genetic differences between animals in net profitability per cow joined in a commercial herd, run in a sub-tropical environment, and producing 620 kg steers for export. It is now referred to as an Export Production Index.

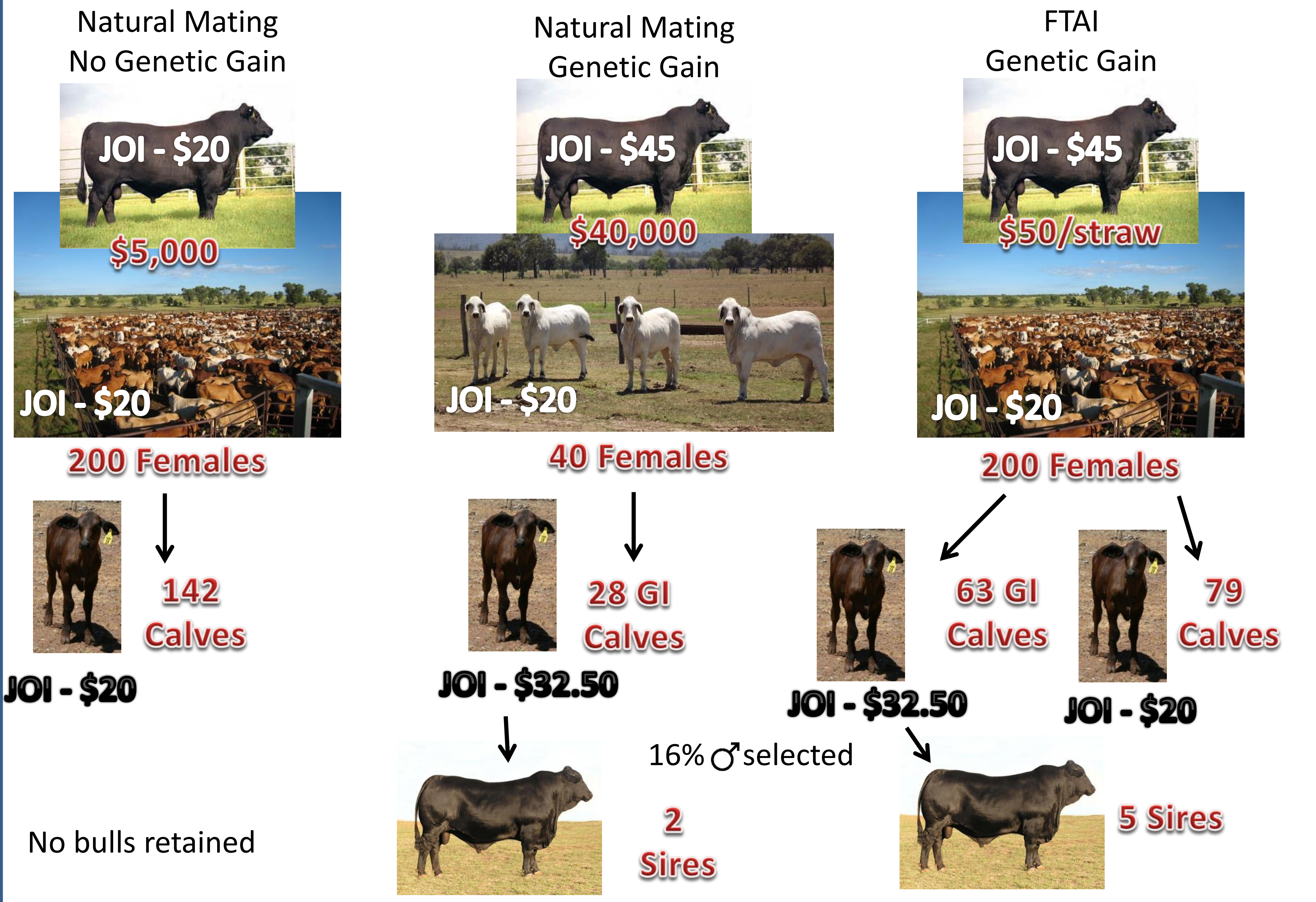
- Bulls produced in year 1 from genetically elite sire used for mating in year 3

- Cost of calf produced by each strategy calculated

- Genetic gain was calculated for each strategy using the following equations: [(Sire Jap Ox Index) – ($20)]/2 = Calf Genetic Improvement.

- For further details (Edwards SAA, Burns BM, Allen J, McGowan MR (2013) Potential economic return from use of fixed-time artificial insemination as part of a genetic improvement programme. 20th Conference Association for the Advancement of Animal Breeding and Genetics p.90-3)

Estimating return on investment in FTAI

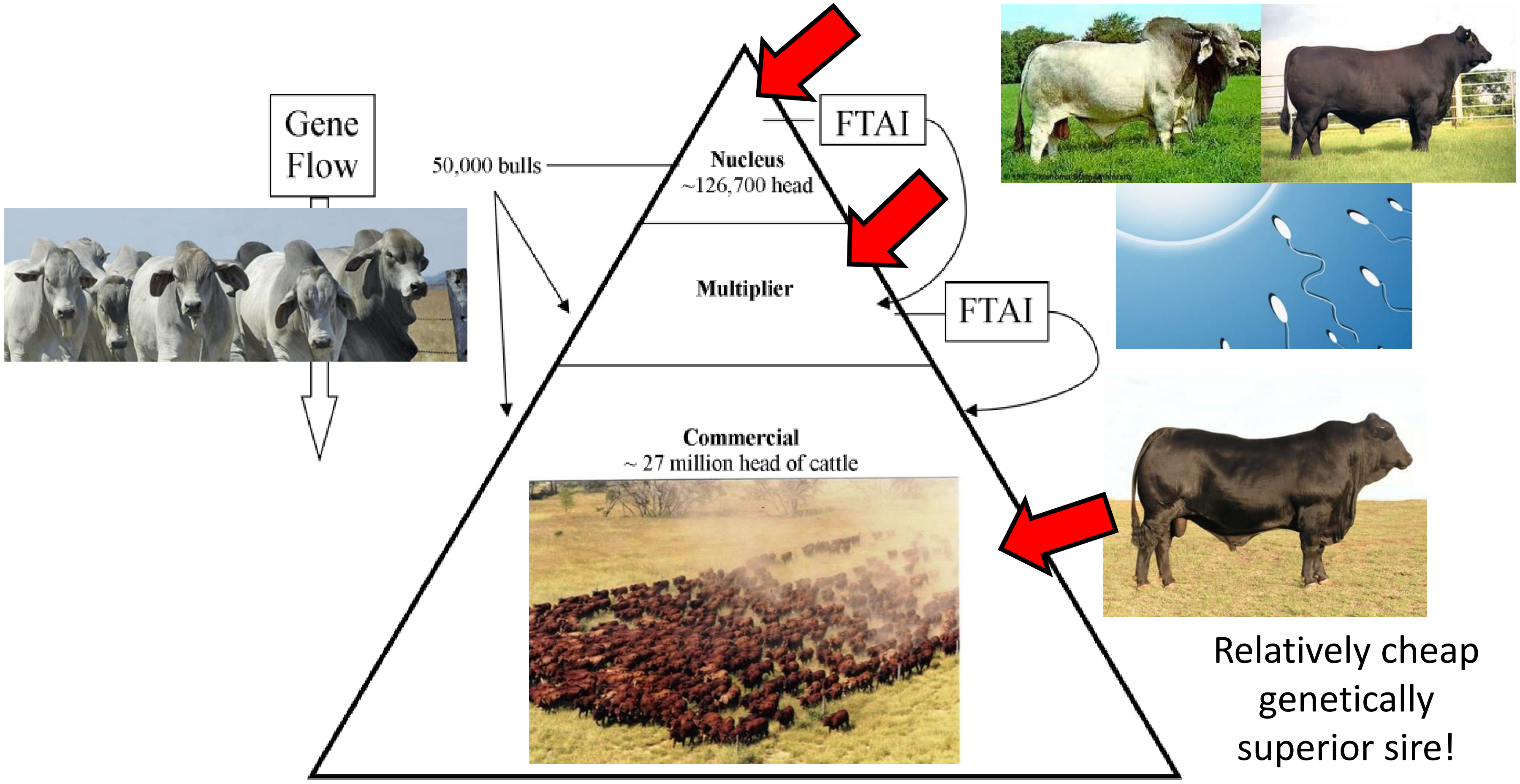


Year 1	*NM*	*NMG*	*FTAIG + NM*
Bull breeding herd (n)	200	40	200
Ovulation synchronisation + semen costs	-	-	$ 15,024.00
Cost per bull used	$ 5,000.00	$ 40,000.00	$ 5,000.00
Bulls used	5	1	5
Total bull costs	$ 25,000	$ 40,000.00	$ 25,000*
Labour costs	$ 400.00	$ 400.00	$ 3,400.00
Mating costs	$ 6,650.00	$10,400.00	$ 6,650.00
Progeny by high genetic merit bull	-	28 calves	63 calves
Progeny by average genetic merit bulls	142 calves	-	79 calves
Cost per calf	**$ 46.83**	**$ 371.42**	**$173.76**
Year 3	*Natural mating using sires generated in Yr 1*		
Bull breeding herd (n)	200	80	200
Cost per bull used	$ 5,000.00	$ 371.42	$173.76
Bulls used	5	2	5
Total bull costs	$ 25,000	$ 742.84	$ 868.80
Labour costs	$ 400.00	$ 400.00	$ 400.00
Mating costs	$ 6,650.00	$ 585.71	$ 617.20
Progeny from mating	142 calves	57 calves	142 calves
Total cost per calf	**$ 46.83**	**$ 10.27**	**$ 4.35**

Genetic profit' after mating genetically improved bulls generated in Year 1

	NM	NMG	FTAIG + NM
Bull breeding herd(n)	200	80	200
Jap Ox Index of sire	$ 20.00	$ 32.50	$ 32.50
Progeny from mating	142 calves	57 calves	142 calves
Genetic gain over average females	$ 0	$ 6.25	$ 6.25
Genetic gain – replacement females - Yr 1	$ 0	$ 175.00	$ 400.00
Progeny from mating	140 calves	56 calves	140 calves
Total genetic gain of progeny - Yr 3	$ 0	$ 62.25	$ 875.00
Total Genetic Profit	**$ 0**	**$ 237.25**	**$ 1275.00**

Accelerating the rate of genetic improvement for key production traits



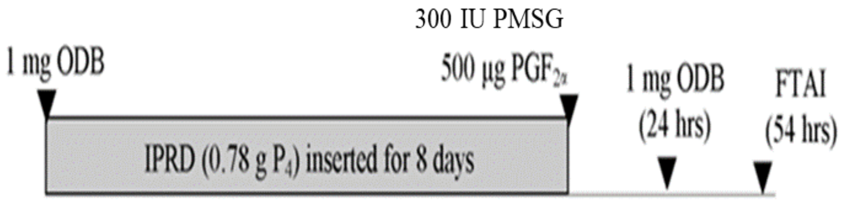
Relatively cheap genetically superior sire!

FTAI v’s AI after detection of oestrus (ODAI)

- FTAI requires hormonal treatments to synchronise ovulation
- However can AI much larger number of heifers/cows on a single day compared to ODAI

Comparison of cost per calf born using ODAI v's FTAI

- *Edwards et al (2015) Theriogenology 83:114-20*
- ODAI - 5 days heat detection + $PGF_{2\alpha}$ + 5 days heat detection
- FTAI



- Percentage of heifers AI:

ODAI – 52%

FTAI – 100%

Comparison of cost per calf born using ODAI v's FTAI

- Overall pregnancy rate: ODAI – 23% (**63**/273)
  FTAI – 35% (**97**/280)
- Cost per AI calf born – ODAI - $291
  - FTAI - $268
- Semen costs – ODAI – 31% of total cost
  - FTAI – 43% of total cost
- Labour costs – ODAI – 67% of total cost
  - FTAI – 42% of total cost

Other important potential benefits of FTAI

- Can greatly reduce required mating period, and hence calving period, thus enabling ‘best practice’ nutritional and health management of herd
- Can increase total kg weaned due to greater proportion of calves born early in calving period
- For example in rising 2-yr-old Brahman heifers where FTAI was followed by mating to bulls which had passed a BBSE 65 to 84% were pregnant within 5 weeks of commencement of mating
- Also becoming pregnant to FTAI is a heritable trait (Porto-Neto LR, Edwards S, Fortes MR, Lehnert SA; Reverter A and McGowan M (2015). Genome wide association for the outcome of fixed time artificial insemination of Brahman heifers in northern Australia. J. Anim. Sci. 2015.93:1–9)

FTAI can also significantly increase the rate of change in selected traits

For example changing from a primarily a horned to a polled genotype

We want to eliminate the need to dehorn cattle in northern Australia

- Dehorning can result in calf deaths (2% even with best practice procedures)
- For an individual pregnant cow, the costs of failure to wean a calf are, annual live weight production drops by an average of 130 kg, and business profit drops by at least $400.
- Reduced liveweight gain after dehorning

Achieving a successful FTAI programme

- Planning should start at least 12 months before AI
    - heifers
    - cows
- Nutritional management
- Vaccinations
- Quality of frozen-thawed semen must always be checked
- Bulls to be used after FTAI should have passed a breeding soundness examination

The inherent fertility of a herd influences pregnancy rate to FTAI

2-year-old Brahman heifers either natural mating with fertile bulls or FTAI. Pregnancy rate per oestrous cycle from natural mating X proportion of heifers treated to synchronise ovulation which respond normally (75%)

Actual PR to FTAI

Herd A:

Estimated PR to FTAI

58.3% (NMPR) x 75% = 43.7%

43.4%

Herd B:

Estimated PR to FTAI

34% (NMPR) x 75% = 25.5%

27.1%

Be careful comparing pregnancy rates from different programmes when the number of females AI'd is <100

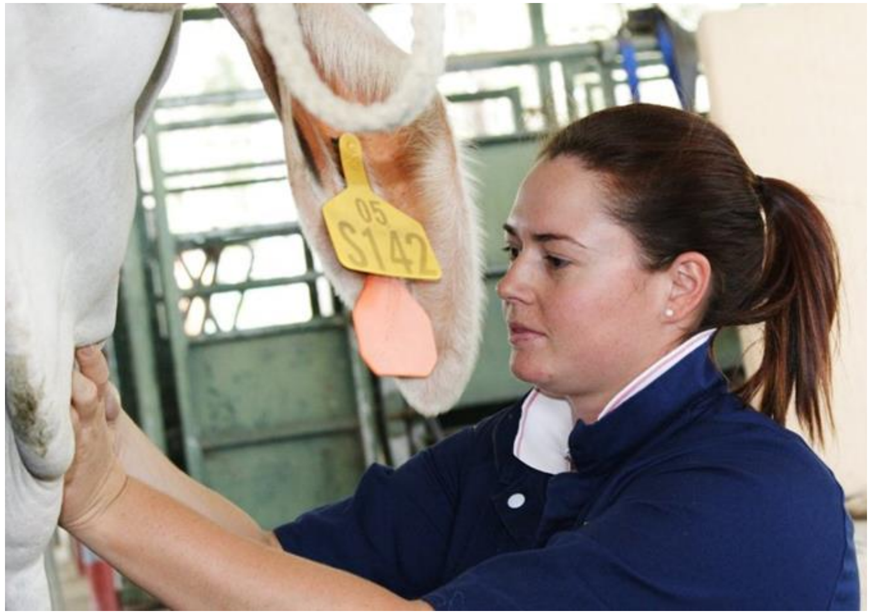
Variation around true pregnancy rate by chance alone

	Actual pregnancy rate in population			
Females AI'd	**20%**	**40%**	**60%**	**80%**
20	2 – 38	18 – 62	38 – 82	62 - 98
50	9 – 31	26 – 54	46 – 74	69 - 91
100	12 – 28	30 – 50	50 – 70	72 – 88
250	15 – 25	34 – 46	54 – 66	75 – 85
500	16 – 24	36 – 44	56 – 64	76 - 84

Key take home messages

- FTAI is a cost effective method of producing genetically superior replacement bulls and heifers for a herd
- Rate of genetic improvement is greater with FTAI compared to natural mating
- FTAI enables cost effective AI of large numbers of selected females
- Success of FTAI programmes depends on careful planning which should commence 12 months prior to planned AI

Acknowledgements



Dr Sophia Edwards, The University of Queensland/Vetoquinol
Greg Fawcett, Queensland Dept. Agriculture and Fisheries
Dr Brian Burns, Queensland Dept. Agriculture and Fisheries
Dr Jack Allen, ABRI, University New England
Dan Lynch, Tara Station, Cloncurry
Lyndon Constable, Vetoquinol, Australia
Professor Gabriel Bo, Instituto de Reproducción Animal Córdoba, Argentina

mla
MEAT & LIVESTOCK AUSTRALIA

vetoquinol
ACHIEVE MORE TOGETHER

THANKYOU FOR YOUR ATTENTION - QUESTIONS