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Conference paper

APPLICATION OF REPRODUCTIVE TECHNOLOGIES

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Introduction

Cloning is an extreme form of reproductive boosting. Clonal propagation has long been used in plant breeding - it exploits the genes in the best individuals, but it also exploits the favourable way in which these genes work with each other in these individuals.

These favourable partnerships can be broken down when they are mixed with other genes in the normal breeding cycle.

Thus, clones are somewhat static - they are good at providing high productivity, but not so good at creating a new generation of better performing individuals. The latter requires genetic variation - variation from which the new elite can be chosen.

This variation is generally not lost with other forms of reproductive boosting. These can lead to some of the direct benefits of clones, but with a maintenance of genetic diversity which can lead to further gains in the following generations.

Reproductive boosting - increasing prolificacy.

Artificial insemination has been used for many years to increase fecundity of males. More recently, MOET has played a similar but less dramatic and less commercially viable role for females.

However techniques for manipulating waves of follicular activity have resulted in recovery of high numbers of oocytes from females. This has also been successful at a research level with juvenile animals such as six-week-old lambs and eight months old calves, whereby the reduction in generation interval is expected to lead to notable increases in rates of genetic gain. However, it should be noted that there are considerable animal welfare issues associated with these procedures on juvenile animals.

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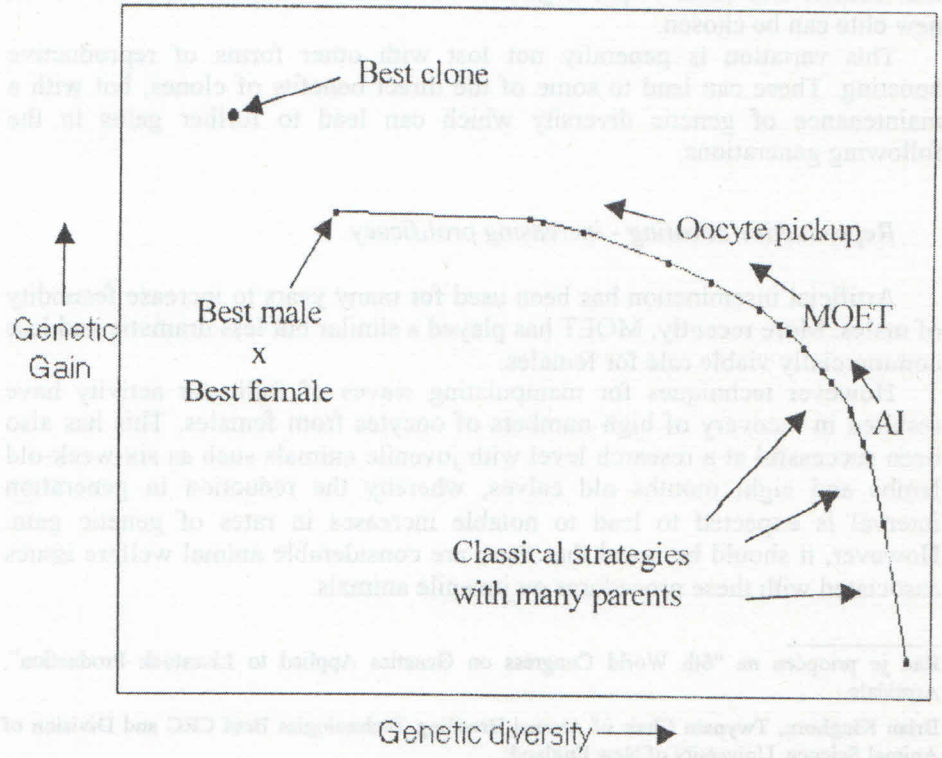
If we succeed in having a high degree of control over fecundity, we are left with the decision of how best to use it. Figure 1 shows that reproductive boosting gives higher genetic gain, but at a penalty of lost genetic diversity. This is especially true at the extreme, where the very best male and female are mated to each other to yield all progeny of the next generation, through surrogate mothers.

This loss in diversity can lead to high inbreeding and reduced gain in the longer term. At the extreme, it also constitutes high risk, by putting all the eggs in one basket'. However, appropriate management of AI, MOET and oocyte pickup across breeding units can result in acceptably low compromise in genetic diversity within a breed or line.

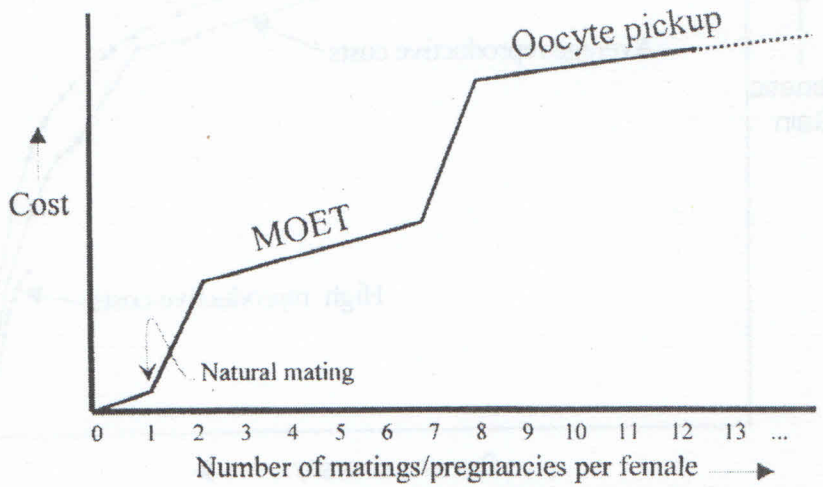
Figure 1. - PREDICTED RESULTS FROM APPLYING DIFFERENT BREEDING STRATEGIES TO A SMALL SIMULATED HERD. INCREASED BOOSTING OF REPRODUCTION GIVES MORE GENETIC GAIN IN THE NEXT GENERATION, BUT AT THE EXPENSE OF LESS GENETIC DIVERSITY



Application with consideration of operating costs

These reproductive techniques are expensive - they should only be applied where their impact is sufficient to make it worthwhile. A tactical approach to decision making has been developed for this. The method nominates which individuals should be boosted according to the predicted impact on genetic gain, genetic diversity and operating costs. Cost of reproductively boosting animals should be calculated in the same units as the breeding objective, and given for each level of boosting - as shown for females in figure 2.

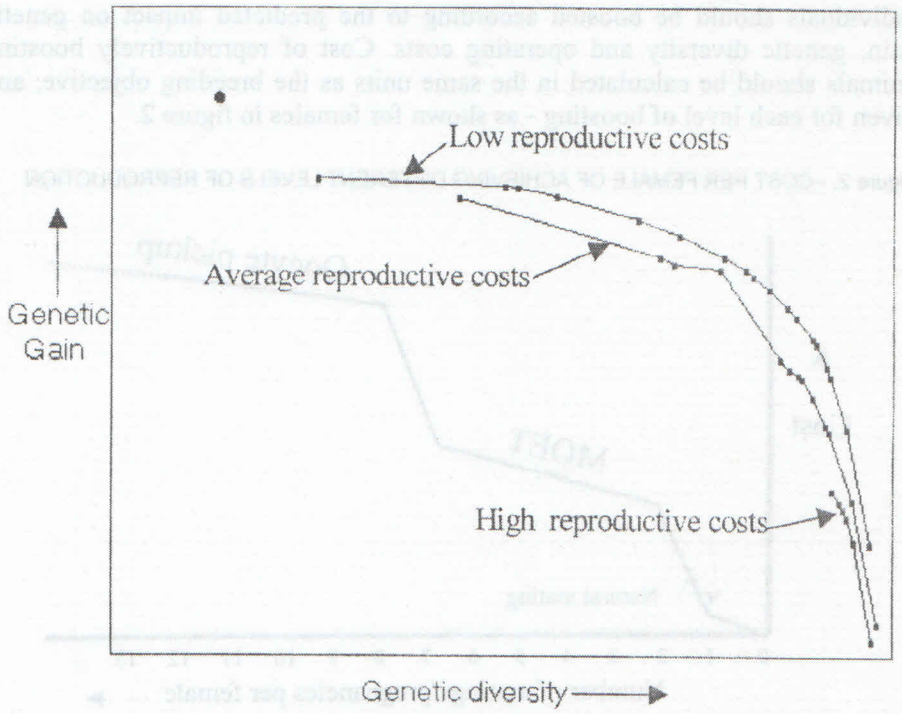
Figure 2. - COST PER FEMALE OF ACHIEVING DIFFERENT LEVELS OF REPRODUCTION



One way of running this method is to set a minimum level of genetic diversity which must be maintained, then maximise net profit as a function of genetic gain and operating costs. If costs are too high, novel reproductive techniques will simply not be used, unless justified by the availability of exceptionally good individual candidates. An example result is shown in figure 3. With low costs, there is a more favourable range of possible outcomes, in terms of genetic gain and genetic diversity. For example, an exceptional cow that is not related to any other candidate for selection can be used more widely through oocyte pickup. Impact on genetic gain is favourable, as can be impact on genetic diversity because of the 'new blood' she brings.

As costs rise (or as technical feasibility diminishes) this sort of option is not available. When costs are sufficiently high, natural mating is the only option, as shown by the smallest curve in figure 3.

Figure 3. - PUTTING COSTS ON REPRODUCTIVE BIOLOGY RESTRICTS ITS USE AND NARROWS THE OPTIONS FOR GENETIC GAIN AND DIVERSITY. EACH POSSIBLE SOLUTION (EACH POINT ON EACH CURVE) REPRESENTS A SELECTION AND MATE ALLOCATION LIST GENERATED. THE BREEDER CHOOSES THE DESIRED SOLUTION



Conclusion

This short paper has outlined a tactical approach to adoption of reproductive boosting technologies such as AI, MOET, and Oocyte pickup. The advantage with a tactical approach is that the design depends on the actual animals available at the time of making selection and mating decisions. This gives a rational approach to exploiting the prevailing resources and opportunities, including high EBV animals, 'new blood' from foreign populations, seedstock costs for these animals and costs of applying reproductive technology.

Design considerations such as these are critical for proper exploitation of new technologies. It is no good betting lots of money on the wrong horses - and it is no good going fast if the direction is wrong.

PRIMJENA REPRODUKTIVNIH TEHNOLOGIJA

Sažetak

Kloniranje je krajnji oblik reproduktivnog porasta. Klonsko razmnožavanje već se dugo primjenjuje u uzgoju bilja – ono iskorištava gene u najboljim jedinkama ali isto tako i povoljan način na koji geni djeluju međusobno u tim jedinkama. Ta se povoljna udruživanja mogu prekinuti kad se izmiješaju s drugim genima u normalnom uzgojnom ciklusu.

Prema tome, kloni su u neku ruku statični – oni su dobri za postizanje visoke produktivnosti, ali ne tako dobri za stvaranje nove generacije jedinki bolje performance. Za to je potrebno genetsko variranje – variranje iz kojeg se može izabrati nova elita.

Ovo se variranje uglavnom ne gubi s drugim oblicima reproduktivnog porasta. Oni mogu dovesti do nekih izravnih prednosti klona, ali s održavanjem genetske raznolikosti, što može voditi do novih dobitaka u slijedećim generacijama.

Ovaj je kratak rad izložio taktički pristup prihvaćanju reprodukcijskog poticanja tehnologija kao što su A1, MOET i Oocyte. Prednost taktičkog pristupa je u tome da plan ovisi o stvarnim dostupnim životinjama kad se donose odluke o selekciji i sparivanju. Ovo daje racionalan pristup iskorištavanju općih resursa i prilika uključujući životinje visokog EBV-a, "nova krv" iz stranih populacija, troškove zaliha sjemena i troškove primjene reproduktivne tehnologije.

Takva razmatranja plana važna su za ispravno iskorištavanje novih tehnologija. Nema koristi od klađenja s mnogo novca na krive konje – i nema koristi od žurbe u krivom smjeru.

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